3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Affected Environment for the proposed Doty Mountain project discusses environmental, social, and economic factors currently existing within the Doty Mountain Project Area (Project Area). The Project Area includes the Doty Mountain Plan of Development (POD) and the pipeline corridor, which extends southwest from the proposed well locations (Figure 2-1). The material presented here has been guided by management issues identified by the RFO, public scoping, and by interdisciplinary field analysis of the area. The critical elements, as listed in BLM's NEPA Handbook H-1790-1 (BLM 1988b), and other resource elements of the human environment have been considered. The elements of the human environment, including critical elements, their status in the Project Area, and their potential to be affected by the proposed Project are listed in Table 3-1. Those items listed as "none present" would not be affected or impacted by the project or the No Action alternative and are not addressed further in this document.

TABLE 3-1 ELEMENTS OF THE HUMAN ENVIRONMENT
ATLANTIC RIM INTERIM DRILLING PROGRAM 2003
DOTY MOUNTAIN PROJECT, CARBON COUNTY, WYOMING

Element	Project Area Status	Addressed in Text
Geology, Minerals and Paleontology	Potentially Affected	Yes
Climate and Air Quality	Potentially Affected	Yes
Soils	Potentially Affected	Yes
Water Resources (including surface and groundwater quantity and quality)	Potentially Affected	Yes
Vegetation, Wetlands, and Noxious Weeds (including riparian zones, invasive species, threatened and endangered species, and species of special concern)	Potentially Affected	Yes
Range Resources and Other Land Uses	Potentially Affected	Yes
Wildlife and Fisheries (including threatened and endangered species, and species of special concern)	Potentially Affected	Yes
Recreation	Potentially Affected	Yes
Visual Resources	Potentially Affected	Yes
Cultural Resources	Potentially Affected	Yes
Socioeconomics	Potentially Affected	Yes
Environmental Justice	Potentially Affected	Yes
Transportation	Potentially Affected	Yes
Health and Safety	Potentially Affected	Yes
Noise	Potentially Affected	Yes
Areas of Critical Environmental Concern	None present	No
Prime or Unique Farmlands	None present	No
Floodplains	None present	No
Native American Religious Concerns	Potentially Affected	Yes
Hazardous or Solid Wastes	Potentially Affected	Yes
Wild and Scenic Rivers	None Present	No
Wilderness	None Present	No

3.2 GEOLOGY, MINERALS, AND PALEONTOLOGY

3.2.1 Physiography, Topography, and Landforms

The Project Area occupies the southeastern portion of the Greater Green River Basin, a large intermontane structural and topographic basin that is part of the Wyoming Basin Physiographic Province. The Project Area is located in an area that has been heavily dissected by the tributary drainages of Dry Cow Creek and Muddy Creek. Landforms consist of ridges, finger ridges, knolls, and hills. Slopes are gentle to moderate. Elevations range from 6,700 feet to 7,300 feet. Wyoming State Highway (WY) 789 via WY 70 or Interstate-80 (I-80), Carbon County Road 608 (Wild Cow Road), upgraded BLM roads, and two-track trails provide access to the Project Area.

3.2.2 Geology

The Greater Green River Basin began developing about 70 million years ago and filled with sediments derived from the eroded Wind River Range to the north during the late Cretaceous and early Tertiary Periods. The Project Area lies within the northern part of the smaller Washakie Basin, where the Lewis Shale of Late Cretaceous age is exposed at the surface. This formation consists of a thick sequence of shale, siltstone, and sandstone that accumulated in deltaic, interdeltaic, and marginal marine environments within a shallow epicontinental sea that extended northward from the Gulf of Mexico to the Arctic Ocean in Maestrichthian time (Winn et al. 1985a, 1985b, 1985c). The Lewis Shale is underlain by 12,000 feet of sedimentary rock, which in turn lies on a basement complex of Precambrian metamorphics and intrusives. The configuration of the basement rock forms the Washakie Basin at depth. At the surface, structural features define the basin margins. These structural features include the Great Divide Basin to the north, the Rock Springs Uplift to the west, the Cherokee Arch to the south, and the Sierra Madre Mountains to the east.

By Late Cretaceous time, this seaway had retreated eastward and the marine deposits of the Lewis Shale were replaced progressively upward by beach, estuarine, and continental deposits of the Fox Hills Sandstone and Lance Formation that spread westward in response to the Sevier and Laramide orogenies. The Laramide orogeny resulted locally in the uplift of the Sierra Madre Mountains and the subsidence of the Washakie Basin. The basin was filled with Tertiary deposits of the Fort Union Formation during Paleocene time and with deposits from the Wasatch Formation during Eocene time.

In places atop modern terraces and buttes along the Muddy Creek and Cow Creek drainages, the Lewis Shale is overlain by a thin veneer of much younger, unconsolidated sediments of Quaternary age. The Muddy Creek drainage is located about 1.5 miles to the north, and the Cow Creek drainage is located about 3.2 miles southeast of the Doty Mountain area. The unconsolidated sediments include alluvium, colluvium, stream terrace gravels, and wind-blown sands that are Late Pleistocene to Holocene in age.

Underlying the Lewis Shale in the Project Area is the Mesaverde Group, which contains abundant sand, carbonaceous shale and coal. The Mesaverde Group is exposed at the surface along the western slope of the Sierra Madre Uplift and is more than 2,500 feet thick. Resistant sandstone beds of the Mesaverde Group form the Atlantic Rim escarpment located immediately north of the Project Area.

Numerous thin coal seams are present in the Allen Ridge, Pine Ridge and upper Almond Formations, which are members of the Mesaverde Group. These coal beds are targeted as exhibiting the greatest potential for gas production. The lateral continuity of the coal seams is variable (Hamilton 1993). Geophysical logs from test wells in the Atlantic Rim EIS study area indicate that the coal beds are somewhat laterally discontinuous; however, data to correlate the coal seams are limited.

Late Cretaceous rocks exposed at the surface and underlying the Project Area consist of a complex sequence of sedimentary units, including sandstone, shale, coal, and carbonaceous shale. These sediments were shed from the Sevier orogenic belt to the west and were deposited along the western edge of the interior Cretaceous sea (Roehler 1990). Deposition occurred predominantly during two major transgression-regression periods of the sea. Late Cretaceous and younger rocks at the surface are underlain by Phanerozoic sedimentary rocks that range from Cretaceous to Cambrian in age. The Phanerozoic sediments are underlain by Precambrian metamorphic bedrock that makes up part of the ancient North American shield.

3.2.3 Mineral and Energy Resources

The three primary mineral commodities that occur in Carbon County are coal, natural gas, and oil (Hoffman and Nunley 2000). Production of these mineral resources has occurred in the Project Area, with coal mining being the least significant production to date. Additional mineral resources within the Project Area include construction aggregate.

The Washakie Basin has been explored and developed for oil and gas resources for many years. A number of formations have been productive; however the Mesaverde Group and more specifically the Almond Formation, has produced the most oil and gas resources. The coal beds of the Mesaverde Group, underlying the Lewis Shale, are the objective for the exploratory wells proposed under the project.

There are no existing or plugged and abandoned wells in the Project Area. However, WOGCC records contain eight permits to drill wells in Section 14, T17N, R91W; six expired permits to drill and two current permits to drill wells in Section 22, T17N, R91W; and nine permits to drill wells (including one disposal well) in Section 23, T17N, R91W.

There are existing oil and gas wells in the Cow Creek Unit near the lateral sales pipeline route. In Section 6, T16N R91W, an oil well drilled to the Niobrara Formation was plugged and abandoned in 1966. There is also one shut-in gas well in Section 6. There are three plugged and abandoned oil wells in Section 1, T16N R92W, that were drilled to the Morapos or the Frontier Formations in the 1960s and 1970s. There is a plugged gas well (dated 1998) drilled to the Deep Creek Formation in Section 12, T16N R92W, near the termination point for the lateral sales pipeline. Two wells are currently producing in

Section 12, T16N 92W. One is producing oil and gas, and the other is producing gas only; both are near the terminus of the lateral sales pipeline route. In addition, five shut-in wells, one active injection well, and one abandoned well, are located in Section 12, T16N R92W.

Coal reserves in the Greater Green River Basin have been estimated at nearly 1,300 trillion tons (Scott et al. 1995). Coal occurs in the Mesaverde Group and the Fort Union Formation in the Washakie Basin. Coal occurs primarily in the Allen Ridge, Pine Ridge and Almond Formations within the upper part of the Mesaverde Group in the Doty Mountain area. The coal is sub-bituminous to high-volatile C bituminous in rank (Tyler et al. 1995). Two coal bed natural gas (CBNG) fields have been explored in the eastern Washakie Basin: the Dixon Field (T12N R90W), and the Cow Creek Field (T16N R92W), both of which target coal seams in the Mesaverde Group.

3.2.4 Geologic Hazards

Potential geologic hazards include landslides, subsidence, and known or suspected active faults. No known active faults with evidence of Quaternary movement or earthquake epicenters occur within the Project Area (Gary Holsan Environmental Planning [GHEP] 2003). Landslide potential is greatest in areas where steep slopes occur, particularly where rock layers dip parallel to the slope, or where erosional undercutting may occur. Slope gradients in the Project Area typically are gentle to moderate, although locations proposed for wells are predominantly along mildly sloping areas. Unstable soils in steep areas such as ridges or buttes may also be susceptible to slumping, sliding, and creeping.

An earthquake that measured 4.3 on the Richter scale occurred on April 4, 1999, 5.2 miles southeast of the Project Area, with its epicenter near Baldy Butte in T17N R92W (41.45°N, 107.74°W) (GHEP 2003). No other earthquake epicenters have been recorded in or immediately adjacent to the Project Area in the past 100 years.

No subsidence hazards or features with potential for subsidence are known to exist within the Project Area.

3.2.5 Paleontology

Paleontological resources include the remains or traces of any prehistoric organism that have been preserved in the earth's crust by natural processes (BLM Information Bulletin WY-93-371). Within sedimentary deposits in the Project Area, paleontological resources serve as a record of the history of animal and plant life in Wyoming during the Late Cretaceous Period. The Lewis Shale represents this period and is known to yield scientifically significant vertebrate fossils in several areas of Wyoming. However, no specific localities have been reported within the Project Area.

Fossils of scientific interest may occur within or in association with energy minerals such as coal, oil shale, lignite, bitumen, asphalt, and tar sands. They may also occur with industrial minerals such as phosphate, limestone, diatomaceous earth, and coquina. Fossils of scientific interest include those of interest to professional paleontologists and educa-

tors, or any vertebrate fossil. If other types of fossils are discovered in the Project Area, the BLM state director and field managers, in consultation with BLM staff paleontologists or other source of expertise, may consider them of scientific interest.

Fossils known from the Lewis Shale represent a large and varied marine invertebrate fauna, including many genera of bivalves, baculites, scaphites, and ammonites and isurid shark teeth (Breithaupt 1985; Gill et al. 1970). Significant fossils are known from the Lewis Shale from some areas of Wyoming. Still, the potential for discovery of scientifically significant fossils in the Project Area is considered moderate to low when compared with other Late Cretaceous age formations in Wyoming.

3.3 CLIMATE AND AIR QUALITY

3.3.1 Climate

The Project Area is located in a semiarid, upland climate regime of the northern Great Plains that is typified by dry, windy conditions with limited rainfall and long, cold winters. Baggs, Wyoming, located 27 miles south of the Project Area, is the nearest meteorological station. Meteorological measurements have been collected at Baggs at an elevation of 6,240 feet from September 1, 1979, to December 31, 2002 (WRCC 2003).

The average annual precipitation over the period of record at Baggs is 10.7 inches, ranging from 18.5 inches in 1983 to 4.63 inches in 1989. Precipitation is greatest during the summer, although minor peaks occur in May, July, and October. An average of 38.8 inches of snow falls annually. The annual high of 118.9 inches was recorded for the 1984-1985 season (WRCC 2003). The most snow falls in December and January, with mean snowfall of 9.1 inches in December and 8 inches in January. In the Project Area, annual average precipitation is estimated to be about 8 to 9 inches, based on local BLM information and Natural Resource Conservation Service (NRCS) range site descriptions.

Temperatures are generally cooler, frost-free periods are shorter, and both precipitation and snowfall are greater at higher elevations. The region is typically cool, with average daily temperatures ranging from a low of 5 ºF to a high of 33 ºF in mid-winter and between a low of 48 ºF and a high of 86 ºF in mid-summer. Extreme temperatures have ranged from -50 ºF to 100 ºF, and the frost-free period (at 32 ºF) generally occurs from mid-May to mid-September.

Mean annual evaporation ranges from 38 inches (lake) to 55 inches (pan) and potential annual evapotranspiration is 18 inches (U.S. Department of Commerce 1979). Compared with the average annual precipitation of 10.7 inches (WRCC 2003), this mean annual evaporation yields an average annual deficit of 6 inches. These characteristics of the Project Area combine to produce a predominantly dry climate where evaporation exceeds precipitation.

The Project Area is subject to strong and gusty winds, which reflect the channeling and mountain valley flows caused by the complex terrain. During the winter, strong winds and snow often produce blizzard conditions and drifting snow. Comprehensive wind

measurements are collected at the airport in Rawlins, Wyoming, which is nearly 31.5 miles northeast of the Project Area at an elevation of 6,780 feet. However, hourly wind data measurements for December 1994 through November 1995 were collected near Baggs, Wyoming, during the Mount Zirkel Wilderness Area Visibility Study. Based on the data collected at Baggs, 27 miles south of the Project Area, winds originate from the south to southwest nearly 37 percent of the time, and the annual mean wind speed is nearly 10 mph.

3.3.2 Air Quality

The National Ambient Air Quality Standards (NAAQS) and the Wyoming Ambient Air Quality Standards (WAAQS) establish upper limits for concentrations of specific air pollutants. Incremental increases in the ambient concentration of criteria pollutants are regulated under the Prevention of Significant Deterioration (PSD) program. The program is designed to limit the incremental increase of specific air pollutants above a legally defined baseline level, depending on the classification of a location. The Project Area and adjacent areas are identified as PSD Class II, where incremental increases are not as restrictive when compared with the incremental increases allowed in PSD Class I areas.

Emissions are limited within the Project Area, with only a few industrial facilities and residential sources in the relatively small communities and isolated ranches. In addition, the good atmospheric dispersion conditions in the Project Area typically result in low concentrations of criteria air pollutants. Although criteria air pollutants have not been monitored in the Project Area, background values measured in the region are well below the National Ambient Air Quality Standards (NAAQS), Wyoming Ambient Air Quality Standards (WAAQS), and the Colorado Ambient Air Quality Standards (CAAQS). Standards have been established for six criteria air pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in effective diameter (PM_{10}), sulfur dioxide (SO_2), and lead (Pb).

The WDEQ-AQD (1997) and Colorado Department of Public Health and Environment, Air Pollution Control Division (CDPHE APCD 1996) provided data on the background concentration of air pollutants, with the exception of lead. Inferred background concentrations of air pollutants, applicable WAAQS and NAAQS, and Class I and II increments (measured in micrograms per cubic meter, or $\mu g/m^3$) are provided in Table 3-2. Values included in Table 3-2 reflect the most recently available air quality monitoring data collected near the Project Area. An estimate of background concentrations is needed to combine with modeled, project-related impacts to air quality and to compare the total predicted impacts with applicable air quality standards. It is important that the background concentration of each pollutant, model predictions, and air quality standards are all based on the same averaging times.

TABLE 3-2 AIR POLLUTANT BACKGROUND CONCENTRATIONS, STATE AND FEDERAL AMBIENT AIR QUALITY STANDARDS, AND PSD INCREMENTS (µG/M^3)

Pollutant/Averaging Time	Measured Background Concentration	State and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline PSD Class I	Incremental Increase Above Legal Baseline PSD Class II
Carbon Monoxide (CO)				
1-hour	2,299 [a]	40,000	n/a	n/a
8-hour	1,148 [a]	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	10 [b]	100	2.5	25
Ozone (O_3)				
1-hour	117 [c]	235	n/a	n/a
Particulate Matter (PM_{10})				
24-hour	20 [c]	150	8	30
Annual	12 [c]	50	4	17
Sulfur Dioxide (SO_2)				
3-hour (National)	29 [d]	1,300	25	512
24-hour (National)	18 [d]	365	5	91
24-hour (Wyoming)	18 [d]	260	n/a	n/a
Annual (National)	5 [d]	80	2	20
Annual (Wyoming)	5 [d]	60	n/a	n/a

Notes:
- Data for measured background concentration of ozone are the top tenth percentile maximum 1-hour value during July; other short-term background concentrations are second-maximum values measured.
- N/A - not applicable
- Wyoming Ambient Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2 – Ambient Standards
- National Ambient Standards from: Title 40 Code of Federal Regulations (CFR) Part 50
- PSD Increments from: 40 CFR Parts 51 and 52 Prevention of Significant Deterioration for Particulate Matter, EPA Final Rule. Federal Register Vol. 58, No. 105, Thursday, June 3, 1993.
- Background Air Quality Data Sources:

a Data collected at Rifle and Mack, Colorado, in conjunction with proposed oil shale development during early 1980s (CDPHE-APCD 1996).

b To supplement monitored NO_2 data, a separate NO_2 modeling analysis was performed, including many oxides of nitrogen (NO_x) emission sources (BLM 1996).

c Data collected at UCG Project, 9 miles west of Rawlins, Wyoming, June 1994 – November 1994 (WDEQ-AQD 1997).

d Data collected at Craig Power Plant site and at Colorado oil shale areas (CDPHE-APCD 1996).

Concern has been expressed in recent years regarding the potential impacts of oil and gas development, and other activities on air quality and Air Quality Related Values (AQRV) in the Class I and sensitive Class II airsheds in the region. The closest federally mandated Class I areas located potentially downwind (northeast or southeast) of the Project Area are the Mount Zirkel Wilderness, 46 miles to the southeast, and the Rawah Wilderness, 82 miles to the southeast, in northern Colorado. The USFS manages both of these areas. Table 3-3 shows Distant Class I and Class II wilderness areas or monuments located within 100 miles of the Project Area.

TABLE 3-3 CLASS I AND II WILDERNESS AREAS AND NATIONAL MONUMENT WITHIN 100 MILES OF THE PROJECT AREA

Area	State	Federal Classification	Distance[a] (miles)	Managed by
Huston Park	Wyoming	II	33	USFS
Encampment River	Wyoming	II	46	USFS
Mount Zirkel	Colorado	I	51	USFS
Savage Run	Wyoming	II[b]	61	USFS
Platte River	Wyoming and Colorado	II	64	USFS
Dinosaur National Monument	Colorado and Utah	II[c]	79	NPS
Rawah	Colorado	I	88	USFS

Notes:
[a] Distances are south and east of the Project Area, except for Dinosaur National Monument, which is southwest of the Project Area.
[b] The State of Wyoming manages the Savage Run Wilderness as a Class I air quality area.
[c] The State of Colorado manages this monument as a Class I air quality area.

Continuous data for the visibility-related optical background were collected at the Class I Bridger Wilderness Area in Wyoming and the Class I Rocky Mountain National Park (just south of the Class I Rawah Wilderness Area) in Colorado, as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. Visibility in the Central Rocky Mountains is very good (averaging more than 70 miles Standard Visual Range), with impacts from fine particles accounting for nearly half of the average degradation (Sisler 1996). In addition, impacts from background atmospheric deposition (acid rain) were monitored at the National Acid Deposition Program/National Trends Network sampling station near Pinedale, Wyoming. In addition, site-specific background data on lake chemistry (pH, acid neutralizing capacity, elemental concentrations, and other factors) have been collected by the U.S. Geological Survey (USGS) Water Quality Division in several high mountain lakes in the nearby wilderness area.

The frequency and strength of the winds greatly affect dispersion and transport of air pollutants. Because of the strong winds in the Project Area, the potential for atmospheric dispersion is relatively high. It is possible that nighttime cooling, which stabilizes air, could inhibit mixing and transport of air pollutants. Dispersion will be the greatest to the north and along the ridges and mountaintops.

The WDEQ-AQD is the primary regulatory agency responsible for evaluating potential impacts when detailed development plans are finalized. Plans for natural gas development are subject to applicable air quality laws, regulations, standards, control measures, and management practices. The State of Wyoming has responsibility, with EPA consultation, for reviewing and permitting proposed emission sources before the Companies

begin operations in the Project Area. The WDEQ-AQD pre-construction air quality permitting would be based on site-specific, detailed engineering values that would be included in the Companies' permit application.

3.4 SOILS

The description of the soils resource forms the basis by which to assess the intensity, duration and magnitude of soil impacts associated with the construction of access roads, well pads, and facilities and to develop effective mitigation measures to prevent, reduce or eliminate impacts to the soils resource. Productivity of soils can be affected by removal of vegetative cover, invasion by undesirable weed species, soil compaction and an increased potential for wind and water erosion. Wind and water erosion potential is, in part, dependent on grain size distribution. For example, clayey soils are sensitive to reduction in permeability through the reduction in the amount and distribution of pore spaces. Reduced permeability can increase runoff of precipitation thereby increasing concentrated overland flow. Reduction in the amount and distribution of porosity can also exacerbate potential for upward migration of soluble salts. In addition, clay in lower horizons of a soil retards permeability and may cause salt to build up in the soil, reducing productivity. In addition to these physical limitations of the soils, in many areas chemical limitations exist primarily in terms of sodium.

The soils in the Project Area have been formally mapped and described at different levels of detail. Munn and Arneson (1999) described the soils within the Project Area using a broad perspective of soils within a large area, at an Order IV or V level of detail. Texas Resource Consultants (1981) and Wells et al (1981) describe the dominant soils in the Project Area at an Order III level of detail. As the survey order number decreases, the level of survey detail or specificity increases. For example, the components of an Order IV map unit are typically phases above the series level, whereas the components of an Order III map unit are typically phases at or below the series level. The Order III soil surveys of the Project Area compliment the survey conducted by Munn and Arneson. The results of these surveys are described in this section.

Munn and Arneson (1999) describe the soils within the Project Area at an Order IV or V level of intensity. Order-IV soil surveys typically include a map scaled at 1:63,360 to 1:250,000, that contains soil map units of approximately 40 to 623 acres. Based on this survey, the Project Area is located within Soil Zone 9, which is characterized as intermontane basin, frigid, and aridic. There are two types of soils in the Project Area: the Ustic Haplargids (CR07) and the Ustic Torrifluvents and Typic Haplocambids (CR10). The Ustic Haplargids soil type is found in the majority of the Project Area; the Ustic Torrifluvents and Typic Haplocambids soil types are found on about 80 acres in T17N R91W, Section 22.

The Ustic Haplargids are fine loamy, mixed, and frigid, and occur on nearly level to gently sloping areas. This soil type is described as very deep and well drained and formed in slopewash alluvium (sediments deposited by running water) derived from shale and sandstone. This soil type is found on terraces, fans, fan remnants, hillslopes, and pediment toeslopes; the slopes generally range from 0 to 15 percent. Livestock grazing and wildlife

habitat are the primary uses of the Ustic Haplagrids soils. Native vegetation supported by these soils is generally big sagebrush, bluebunch wheatgrass, Sandberg bluegrass, and needle-and-thread.

The Ustic Torrifluvents are coarse-loamy, mixed (calc), and frigid. The Typic Haplocambids are fine, montmorillonitic, and frigid.

More detailed soils information is also available for the Project Area. An Order III soil survey was prepared by Texas Resource Consultants (1981) and Wells et al (1981) for the BLM, in cooperation with the Natural Resources Conservation Service (then Soil Conservation Service). Order-III soil surveys typically include a map scaled at 1:20,000 to 1:63,360 that contains soil map units approximately of 4 to 40 acres in size that delineate soil associations and complexes. The soil associations and complexes that are mapped represent various soil series. To augment existing soils data, a field reconnaissance was conducted on September 19, 2003 as part of this analysis, to verify the distribution and properties of soils in the Project Area.

Characteristics of the soil map units delineated within the Project Area according to the Order III survey are presented in Table 3-4. Soils in the Project Area formed in residuum and alluvium derived from Cretaceous and Tertiary shales, siltstones and sandstones. An ustic moisture regime with a frigid temperature regime prevails. Soils typically are dry for more than 90 days, but less than 180 days within a year. The mean annual soil temperature is between 0°C to 8°C (32°F to 47°F).

Textures in surface soil are typically fine sandy loam to loam. The textures in the B-horizon (if present) are typically clay loam to loam. The textures in the C-horizon and regolith are typically clay loam to sandy loam. These soils are classified as well drained. In general, permeability is moderate. Runoff potentials are medium to rapid.

The water and wind erosion hazard classification for disturbed soils is generally moderate to severe. The soil erodibility factor (Revised Universal Soil Loss Equation - K-factor) for these soils varies from 0.28 to 0.49 and the tolerable soil loss is between 1 and 5 tons/acre/year. The soil erodibility factor is a measure of the susceptibility of a soil to erosion based on empirically derived relationships between soil texture, organic matter, structure and permeability. It ranges from 0.1 to 0.64, where higher values indicate a higher susceptibility to erosion. The wind erodibility grouping is 3 to 6. Wind erodibility groupings are explained in Table 3-4.

Soil salinity is generally low and ranges from 2-4 mmhos/cm. The soil horizon pH may range above 8.5 in all or parts of each map unit. Typically, this condition indicates sodic soils.

The average annual aboveground biomass productivity (based on range site classifications) of these soils ranges from 700 to 1500 lbs/acre (on a dry weight basis).

TABLE 3-4 DOTY MOUNTAIN SOIL CHARACTERISTICS

Map Unit #	Map Unit Name	Series (% of map unit)	Taxonomic Classification	Landscape Position	Slope	Soil Parent Material	Horizon	Depth (inches)	Texture	Shrink/Swell	Depth to Bedrock (inches)	Erosion Factor K	Erosion Factor T (tons/ acre/yr)	Wind Erodability Group[1]	Runoff	Drainage Class	Permeability	Erosion Hazard Water	Erosion Hazard Blowing
202	Rentsac - Shinbara Complex	Rentsac - 40%	Loamy-skeletal, mixed (calcareous), frigid, Lithic, Ustic Torriorthents	Gentle to steep upland ridges on residuum	6%-30%	Hard sand-stone	A	0-3	loam, fine sandy loam, sandy loam	NA	18	NA	NA	NA	Medium - Rapid	Well Drained	Moderately - Rapid	Moder-ate	NA
							C	3-15	loam, sandy loam	NA		NA							
		Shinbara - 40%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents		6%-30%	Shale and siltstone	A	0-2	loam	Low	8	0.32	1	4L	Medium - Rapid	Well Drained	Moderate	Moder-ate - Severe	Moderate
							C	2-9	channery loam	Low		0.32							
233	Forelle - Patent Complex	Forelle - 40%	Fine-loamy, mixed Borol-lic Haplargids	Gentle sloping alluvial fans in valleys	3%-6%	Shale	A	0-3	loam	Low	>60	0.28	5	6	Medium	Well Drained	Moderate	Slight - Moder-ate	Slight
							B	3-22	clay loam	Moderate		0.32							
							C	22-60	clay loam	Moderate		0.32							
		Patent - 30%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents		3%-10%	Sedimentary Rock	A	0-9	loam	Moderate	>60	0.32	5-4	4-L	Medium	Well Drained	Moderate	Moder-ate	Moderate
							C	9-60	loam	Moderate		0.32							
		Rock-River, Cushool, and Evanston - 30%																	
235	Blazon - Shinbara Complex	Blazon - 45%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents	Ridgecrests, sideslopes, and footslopes on residuum. Slopes irregular with some highly dis-sected areas	6%-20%	Shale	A	0-10	loam	Low	10-20	0.32	1	4L	Rapid	Well Drained	Moderate	Severe	Moderate
		Shinbara - 30%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents		6%-40%	Shale	A	0-2	loam	Low	2-10	0.32	1	4L	Rapid	Well Drained	Moderate	Severe	Moderate
							C	2-9	channery loam	Low		0.32							
		Rock Outcrop, Seaverson, Cushool and Diamondville - 25%																	
236	Cushool-Worfman-Blackhall Complex	Cushool - 35%	Fine-loamy, mixed Borol-lic Haplargids	Gentle sloping to moderately steep uplands on residuum	6%-15%	Sandstone or sandy shale	A	0-2	fine sandy loam	Low	20-40	0.28	3	3	Slow - Medium	Well Drained	Moderate	Slight - Moder-ate	Moderate - Severe
							B	2-6	loam	Low		0.32							
							C	6-30	sandy clay loam	Low		0.28							
		Worfman - 20%	Loamy, mixed, shallow Borollic Haplargids		6%-20%	Sandstone	A	0-2	fine sandy loam	Low	10-20	0.28	2	3	Medium	Well Drained	Moderate	Moder-ate	Moderate - Severe
							B	2-4	loam	Moderate		0.32							
							C	4-15	sandy clay loam	Moderate		0.32							
		Blackhall - 20%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents		10%-30%	Sandstone	C	0-13	sandy loam	Low	10-20	0.24	1	3	Medium	Well Drained	Moderate	Moder-ate	Moderate - Severe
		Blazon, Chaperton, River Rock, and Rallod - 25%																	
237	Seaverson - Blazon Complex	Seaverson - 40%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents	Undulating to rolling, dis-sected uplands on residuum	3%-15%	Shale	A	0-3	clay loam	Moderate	10-20	0.43	2	4L	Medium - Rapid	Well Drained	Moderately slow	Moder-ate - Severe	Moderate
							C	3-16	clay loam	Low		0.43							
		Blazon - 30%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents		3%-15%	Shale, silt-stone, or loamstone	A	0-15	loam	Low	10-20	0.32	1	4L	Medium - Rapid	Well Drained	Moderate	Moder-ate - Severe	Moderate
		Shinbara - 10%	Loamy, mixed (calcare-ous), frigid, shallow Ustic Torriorthents																

TABLE 3-4 DOTY MOUNTAIN SOIL CHARACTERISTICS

Map Unit #	Map Unit Name	Series (% of map unit)	Taxonomic Classification	Landscape Position	Slope	Soil Parent Material	Horizon	Depth	Texture	Shrink/Swell	Depth to Bedrock	Erosion Factor		Wind Erodability Group[1]	Runoff	Drainage Class	Permeability	Erosion Hazard	
		Abston, Rallod, Delphill, Diamondville, and Rock outcrop - 20%																	
241	Diamondville - Blazon - Forelle Complex	Diamondville - 40%	Fine-loamy, mixed Borollic Haplargids	Hilly uplands with convex ridgecrests, sideslopes, narrow valleys, and short alluvial fans	3%-15%	Shale	A	0-4	loam	Low	20-40	0.37	3	6	Medium	Well Drained	Moderate	Moderate	Slight
							C	4-22	clay loam	Moderate		0.49							
		Blazon - 20%	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents		6%-15%	Shale or loamstone	A	0-11	loam	Low	10-20	0.32	1	4L	Medium - Rapid	Well Drained	Moderate	Moderate - Severe	Moderate
		Forelle - 20%	Fine-loamy, mixed Borollic Haplargids		3%-10%	Shale	A	0-4	loam	Low	>60	0.28	5	6	Medium	Well Drained	Moderate	Slight - Moderate	Slight
							C	4-60	clay loam	Moderate		0.32							
		Delphill, Seaverson, and Mowerson - 10%																	
911	Forelle - Diamondville Loams	Forelle - 60%	Fine-loamy, mixed Borollic Haplargids	Broad alluvial uplands	3%-15%	Shale	A	0-6	loam	Low	>60	0.28	5	3	Medium	Well Drained	Moderate	Moderate	Slight
							B	6-30	clay loam	Moderate		0.32							
							C	30-60	clay loam	Moderate		0.32							
		Diamondville - 20%	Fine-loamy, mixed Borollic Haplargids		3%-15%	Shale	A	0-4	loam	Low	20-40	0.37	3	6	Medium	Well Drained	Moderate	Moderate	Slight
							C	4-25	clay loam	Moderate		0.49							
		Pinelli, Yamac, and Evanston - 2%																	
210		no data available																	
251		no data available																	

NA - data Not Available

Source - Soil Inventory of the Overland Area, Wyoming, Volume 1 - Soil and Land Use Technologies, Inc.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are:

1 Coarse sands, sands, fine sands, and very fine sands.
2 Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3 Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
4L Calcareous loams, silt loams, clay loams, and silty clay loams.
4 Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5 Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6 Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7 Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8 Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

3.5 WATER RESOURCES

3.5.1 Groundwater

Groundwater resources include deep and shallow confined and unconfined aquifers. Site-specific data on groundwater for the Project Area are limited, however. Existing information comes primarily from WOGCC oil and gas well records, Wyoming State Engineer's Office (WSEO) water-well records, and the USGS (Weigel 1987). Regional aquifer systems pertinent to the Project Area are discussed by Heath (1984), Freethey (1987), and Driver et al. (1984). Basin-wide evaluations of hydrogeology specific to the Project Area have been investigated by Collentine et al. (1981). The most relevant hydrogeologic study specific to the Project Area is by Welder and McGreevy (1966). The Project Area is located in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); and the Washakie Basin described by Collentine et al. (1981) and Welder and McGreevy (1966).

3.5.1.1 Location and Quantity

Groundwater in the Washakie Basin is generally found in artesian aquifers, although it is also present in unconfined alluvial valleys and in isolated, saturated outcrops (Welder and McGreevy 1966). Table 3-5 summarizes the water-bearing characteristics of the geologic formations (aquifers) in the Project Area and vicinity. Of the geologic units listed in Table 3-5, Welder and McGreevy (1966) suggest that the units that are capable of producing the largest quantity of water include the following: Quaternary alluvium; Tertiary deposits in the Browns Park, Wasatch, and Fort Union Formations; Cretaceous formations, including Mesaverde Group, Frontier and Cloverly Formations; the Sundance-Nugget Sandstone of Jurassic age; and the Tensleep Formation and Madison Limestone of Paleozoic age.

Quaternary aquifers in the Washakie Basin are made up of alluvial deposits along major floodplains and isolated windblown and lake sediments elsewhere. The major Quaternary aquifers in the vicinity of the Project Area occur in alluvial deposits along the Little Snake River and Muddy Creek and in windblown segments along the Sand Hills. Flow of groundwater within the sandy Quaternary aquifers is typically downward, toward permeable underlying formations (Collentine et al. 1981).

TABLE 3-5 WATER-BEARING CHARACTERISTICS OF GEOLOGIC FORMATIONS IN THE WASHAKIE BASIN

				Hydrologic Properties		
Era	Period	Geologic Unit	Thickness	Well Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft[b])
Cenozoic	Quaternary		0-70	<30	168-560	21-62
	Tertiary	Browns Park Formation	0-1,200	3-30	100-10,000	NM[d]
		Wasatch Formation	0-4,000+	30-50	150-10,000	0.04-18.2
		Fort Union Formation	0-2,700+	3-300	<2,500	<1
Mesozoic	Upper Cretaceous	Lance Formation	0-4,500+	<25	<20	0.007-8.2
		Fox Hill Sandstone	0-400	NM[d]	10-20	0.9
		Lewis Shale	0-2,700+	2-25[b]	0.03-50	0.002-0.9
		Almond Formation[c]	0-600	NM[d]	2,000-8,000	100-800
		Mesaverde Group (incl. Almond Formation)	300-2,800	<100	<3,000	NM[d]
		Baxter Shale (incl. Steele Shale and Niobrara Formation)	2,000-5,000+	Major regional aquitard between Mesaverde and Frontier aquifers. Hydrologic data unavailable.		
		Frontier Formation	190-1,900+	1-100+	<100-6,500	NM[d]
	Lower Cretaceous	Mowry Shale	150-525	Regional aquitard. Hydrologic data unavailable.		
		Thermopolis Shale (inclu. Muddy Sandstone)	20-235	Considered a leaking confining unit. Hydrologic data unavailable.		
		Cloverly Formation	45-240	25-120	340-1,700	1-177
	Upper Jurassic	Morrison Formation	170-450+	Confining unit between Cloverly and Sundance-Nugget aquifers. Hydrologic data unavailable.		
		Sundance Formation	130-450+	27-35	12-3,500	NM[d]
	Lower Jurassic-Upper Triassic	Nugget Sandstone	0-650+	35-200	<2,166	NM[d]
	Triassic	Chugwater Formation	900-1,500+	Confining unit between Sundance-Nugget and Paleozoic aquifers. Hydrologic data unavailable.		
Mesozoic-Paleozoic	Lower Triassic Permian	Phosphoria Formation (incl. Goose Egg Formation)	170-460	Probable poor water-bearing capabilities because of the low permeability. Hydrologic data unavailable.		
Paleozoic	Permian-Pennsylvanian	Tensleep Formation	0-840+	24-400	1-374	NM[d]
	Mississippian	Madison Limestone	5-325+	<400	Variable	NM[d]
Precambrian	N/A	Igneous and metamorphic rocks	Unknown	10-20	<1,000	Generally high in upper 200 ft of unit

Notes

[a] Adapted from Table V-1 in Collentine et al. (1981). Formations that are not encountered in Project Area have been omitted.

[b] From well completion records on file with WSEO.

[c] From Atlantic Rim gas well test data.

[d] NM = Not measured.

Tertiary aquifers in and near the Project Area occur in the Browns Park Formation along the Little Snake River floodplain and adjacent to the Sierra Madre Uplift, the Fort Union Formation near the Muddy Creek floodplain to the west, and isolated outcrops of the Wasatch Formation near the center of the Project Area. Groundwater generally flows west-southwest from the higher elevations along the Sierra Madre Uplift toward the low-lying center of the Washakie Basin and the major streams (Collentine et al. 1981).

Cretaceous aquifers in the Project Area occur in three major geologic formations. From youngest to oldest, they are the Almond Formation of the Mesaverde Group, the Frontier Formation, and the Cloverly Formation. The Mesaverde Group is exposed along the eastern slopes of the Project Area, although a mantle of Tertiary deposits unconformably overlies large areas of Late Cretaceous strata. No outcrops of the Frontier or Cloverly Formations are present within the Project Area.

The Cretaceous aquifers are composed of interbedded sandstone, shale, and coal and have demonstrated considerable yields in existing wells (Collentine et al. 1981). Recharge to these water-bearing strata is principally from infiltration of precipitation and movement of groundwater from the overlying Tertiary sediments at their outcrops and subcrops along the elevated eastern margin of the Washakie Basin. The direction of regional groundwater flow is toward the west, in response to the structural dip and surface topography.

Separated from the Cretaceous aquifers by the impermeable Morrison Formation is the Sundance-Nugget Aquifer of Jurassic age. The Sundance-Nugget aquifer is composed of permeable sandstone with minor quantities of shale, siltstone, and limestone (Collentine et al. 1981). The flow characteristics of the Sundance-Nugget aquifer are not well defined.

The remaining two major aquifers occur in rocks of Paleozoic age. The Pennsylvanian Tensleep Formation consists of fine- to medium-grained sandstone between confining layers of the Chugwater Formation (Triassic) and the Amsden Formation (Pennsylvanian) (Collentine et al. 1981). The Madison aquifer is composed of limestone and dolomite overlain by fine-grained Amsden sediments and underlain by Cambrian rocks. Wells completed in both of these Paleozoic aquifers have demonstrated yields up to 400 gallons per minute (gpm). Groundwater flow is to the south-southeast in the Project Area.

Recharge to the aquifers is generally by precipitation and surface water seepage that percolate through permeable overlying materials (Welder and McGreevy 1966). Driver et al. (1984) suggest that the Browns Park Formation would be the best candidate for large-scale development of groundwater.

3.5.1.2 Quality

Seven permitted water wells have been completed within 1 mile of the Project Area. Six of these wells are located within the inferred circle of influence (within a 1/2-mile radius) of individual exploratory wells. Two of those wells yield water used for stock ponds; the remaining four are monitoring wells. Information on the existing wells is presented in Table 3-6. This information was obtained from the WSEO (Appendix D). The maximum

depth of all permitted wells is 419 feet. Deep injection wells are proposed for the Cherokee and Deep Creek Sandstones, which occur 3,800 to 4,600 feet below the surface. The water wells are much shallower than the proposed gas wells and proposed injection zones.

TABLE 3-6 PERMITTED WATER WELLS WITHIN 1 MILE OF THE DOTY MOUNTAIN PROJECT AREA

Permit No.	Sec	Qtr/Qtr	Applicant	Facility Name	Use	Yield (gpm)	Well Depth	Static Depth
P33768W	15	SWNW	Union Pacific Minerals Inc.	ARW 1	Monitoring Misc.	0	280	144.88
P54262W	23	NWNW	Union Pacific Minerals Inc.	AR 201 OW	Monitoring Misc.	0	220	64
P54264W	23	SESW	Union Pacific Minerals Inc.	AR 200 OW	Monitoring Misc.	0	419	107
P56613W	23	SWNW	P H Livestock Co.	Y Pasture #1	Storage	5	120	35
P59801W	23	NENW	Wyoming Board of Land Commissioners — Pan Artic Exploration LTD	9C-16-19-89	Monitoring Misc.	Unk	Unk	Unk
P59802W	23	SWNW	Wyoming Board of Land Commissioners — Pan Artic Exploration LTD	1-16-19-89	Monitoring Misc.	Unk	Unk	Unk
P17356W	28	NENE	BLM	#4139	Storage	5	100	Unk

Groundwater quality is related to the depth of the aquifers, flow between aquifers, and rock type. Groundwater quality is variable in the Project Area. Total dissolved solids (TDS) are generally less than 2,000 milligrams per liter (mg/L), considered slightly saline to saline, in the Project Area, with local concentrations less than 500 mg/L (meeting EPA National Secondary Drinking Water Regulations).

As most existing groundwater wells and the proposed gas wells of the Project Area occur in aquifers in the Mesaverde Group, a detailed analysis of groundwater from this unit has been included in Table 3-7**.** Sodium and bicarbonate dominate as the major ionic species. Collentine et al. (1981) offers three possible explanations for this dominance: (1) exchange of dissolved calcium for sodium; (2) sulfate reduction, resulting in generation of bicarbonate; and (3) intermixing of sodium-rich, saline water from low-permeability zones within the Mesaverde or adjacent aquifers.

TABLE 3-7 MAJOR ION COMPOSITION OF MESAVERDE GROUNDWATER

Cation	Concentration (mg/L)	Anion	Concentration (mg/L)
Sodium	513	Bicarbonate[a]	1,284
Calcium	7	Carbonate[b]	9
Magnesium	3	Chloride	56
Potassium[a]	5	Sulfate	11

[a] Bicarbonate was not measured; value shown was calculated from ion balance.
[b] Concentrations of potassium and carbonate were not measured in samples from gas wells; values represent composite of USGS data for Mesaverde wells in the vicinity of the project (USGS 1980).

Table 3-8 presents a comparison of Mesaverde groundwater with WDEQ suitability standards. The composite results of samples from the three gas wells analyzed indicate that the water is generally suitable for livestock but is unsuitable for domestic supply or irrigation without treatment. Parameters measured at concentrations that exceed Wyoming drinking water standards include iron, manganese, and TDS. Calculated values for SAR (47.3) and residual sodium carbonate (41 milliequivalents per liter [meq/L]) exceed the agriculture suitability limits of 8.00 for SAR and 1.25 for residual sodium carbonate.

TABLE 3-8 GROUNDWATER QUALITY OF MESAVERDE WELLS IN PROJECT AREA

Parameter	Concentration[a]	Unit	Groundwater Suitability Standards[b]		
			Domestic	Agriculture	Livestock
Aluminum	0.045	mg/L	---	5	5
Ammonia	0.9	mg/L	0.5	---	---
Arsenic	0.0006	mg/L	0.05	0.1	0.2
Barium	0.36	mg/L	1	---	---
Beryllium	<0.002	mg/L	---	0.1	---
Boron	0.25	mg/L	0.75	0.75	5
Cadmium	<0.0002	mg/L	0.01	0.01	0.05
Chloride	56	mg/L	250	100	2000
Chromium	0.002	mg/L	0.05	0.1	0.05
Cobalt	NM	mg/L	---	0.05	1
Copper	0.03	mg/L	1	0.2	0.5
Cyanide	<5	mg/L	0.2	---	---
Fluoride	1.0	mg/L	1.4 - 2.4	---	---
Hydrogen Sulfide	NM	mg/L	0.05	---	---
Iron	3.06	mg/L	0.3	5	---
Lead	0.004	mg/L	0.05	5	0.1
Lithium	NM	mg/L	---	2.5	---
Manganese	0.102	mg/L	0.05	0.2	---
Mercury	<0.0004	mg/L	0.002	---	0.00005
Nickel	0.041	mg/L	---	0.2	---
Nitrate	<0.03	mg/L	10	---	---
Nitrite	<0.03	mg/L	1	---	10

TABLE 3-8 GROUNDWATER QUALITY OF MESAVERDE WELLS IN PROJECT AREA

Parameter	Concentration[a]	Unit	Groundwater Suitability Standards[b]		
			Domestic	Agriculture	Livestock
Oil & Grease[c]	<1	mg/L	Virtually Free	10	10
Phenol	65	mg/L	0.001	---	---
Selenium	<0.005	mg/L	0.01	0.02	0.05
Silver	<0.003	mg/L	0.05	---	---
Sulfate	11	mg/L	250	200	3000
TDS	1,322	mg/L	500	2000	5000
Uranium	NM	mg/L	5	5	5
Vanadium	NM	mg/L	---	0.1	0.1
Zinc	0.3	mg/L	5	2	25
pH	8.2	s.u.	6.5 - 9.0	4.5 - 9.0	6.5 - 8.5
SAR	47.3	<none>	---	8	---
RSC[d]	41	meq/L	---	1.25	---
Radium 226 + Radium 228	0.9	pCi/L	5	5	5
Strontium 90	NM	pCi/L	8	8	8
Gross alpha	NM	pCi/L	15	15	15

a Concentrations of boron, ammonia, fluoride, and nitrate/nitrite from 11 Mesaverde groundwater wells (USGS 1980); remaining concentrations from three Mesaverde gas wells in Project Area.
b From WDEQ Water Quality Rules and Regulations, Chapter VIII.
c Reported as total petroleum hydrocarbons.
d Residual sodium carbonate calculated from measured concentrations of calcium and magnesium and calculated concentration of bicarbonate.

Notes:

meq/L = Milliequivalents per liter
mg/L = Milligrams per liter
NM = Not measured
pCi/L = Picocuries per liter
s.u. = Standard units
TDS = Total dissolved solids

The confining beds slow movement of water, and hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the surface units, most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming over degradation of groundwater quality caused when confining layers are pierced and allow vertical and horizontal migration and mixing of water of variable qualities. Data that would suggest this degradation is a current problem in the Project Area are not available.

3.5.2 Surface Water

The Project Area is located in Muddy Hydrologic Unit Code (HUC) 14050004, upstream of the Little Snake (HUC 14050003) in the Upper Colorado River Basin. The nearest perennial stream is Muddy Creek, located 1.5 miles north of the Project Area. Muddy Creek originates in the Sierra Madre. It flows west and south of the Project Area to its confluence with the Little Snake River near Baggs. Four unnamed ephemeral drainages that are tributary to Dry Cow Creek traverse the Project Area. Dry Cow Creek is also an intermittent stream that flows southwesterly about 9 miles to its confluence with Cow Creek. Cow Creek is a perennial stream that is tributary to Muddy Creek.

3.5.2.1 Quantity

Annual flows for all channels within the Project Area generally occur in response to snowmelt during February through April, or from thunderstorms in the summer and fall. There are no stream gaging stations in the Project Area since all drainages are ephemeral. A USGS gaging station located on the Little Snake River near Dixon, recorded a maximum peak discharge of 13,000 cubic feet per second (cfs) on May 16, 1984, while minimum flows of near 0 cfs occur in late summer and early fall at the end of the irrigation season (Druse et al. 1994). At the BLM gaging station on Muddy Creek at Dad Road, an average flow of 984 cfs was measured from April to July in 1993, with maximum flow measured in May at 2,913 cfs and the minimum flow in June at 10.2 cfs.

3.5.2.2 Quality

There are seven existing USGS surface water gaging stations in the vicinity of the Project Area, including two on the Little Snake River, two on Muddy Creek, and one each on Cow Creek, Dry Cow Creek, and Wild Cow Creek. Wild Cow Creek is a perennial stream located south of Cow Creek that flows southwest to its confluence with Muddy Creek. Although no data are being collected currently, water quality samples were collected at these gaging stations from as early as 1957 to as recently as 1997. A maximum of 107 samples were collected on the Little Snake River (HUC 09257000) and a minimum of three samples were collected on Muddy Creek (HUC 09258900). Average sample water quality data from each of the stations are shown in Table 3-9.

TABLE 3-9 AVERAGE DATA FOR SURFACE WATER QUALITY IN THE PROJECT AREA

	USGS Surface Water Quality Station[a]							
Parameter	**Cow Creek**	**Dry Cow Creek**	**Little Snake River**	**Little Snake River**	**Muddy Creek**	**Muddy Creek**	**Wild Cow Creek**	**Muddy Creek at Dad Road[g]**
Station Number	09115080	09258200	09257000	09259050	09258900	09259000	WLDCWCK:0	MCDAD:O
Sample Period	1978-1979	1975-1980	1957-1988	1980-1997	1976-1978	1957-1991	1986-1993	April 1993-July 1993
Number of Samples[b]	20	9	107	100	3	41	42	4
pH, standard units	9.2	8.6	8.1	8.1	8.6	8.2	9.0	8.1 (Lab)
Specific Conductance, mmhos/cm	2,925	2,162	259	366	1,350	966	2,663	782.2 (Lab)
Total Dissolved Solids (TDS)[c]	1,801	1,438[d]	158	243	913	630[d]	1,955	549
Total Suspended Solids (TSS)	133	1,111	154	228	6,198	3,191	NM[e]	248
Turbidity[f]	284 NTU	1,013 JTU	13 JTU	167 NTU	1,260 NTU	NM	NM	NM
Hardness as $CaCO_c$	174	37	111	151	315	270	334	336
Dissolved Oxygen	9	11	9	10	11	10	NM	NM
Sodium	560	98	11	26	200	286	550	47.5
Calcium	19	9	30	34	54	42	20	88.5
Magnesium	31	4	8	12	44	40	68	27.4
Potassium	11	4	2	2	7	9	7	3.74
Bicarbonate	870	170	159	190	373	308	1,000	237
Carbonate	186	4	0	1	0.5	NM	91	0.84
Sulfate	181	65	25	54	380	320	438	247
Chloride	132	21	3	2	65	32	60	7.86
Fecal coliform, #/100 ml	535	NM	NM	351	NM	8	NM	NM

Notes:

[a] Data available on the Internet at http://www.wrds.uwyo.edu

[b] Total number of grab samples analyzed; not every parameter was analyzed in every sample

[c] All units are mg/L except as noted

[d] TDS calculated from specific conductance because of lack of sample data

[e] NM = not measured

[f] Measured in Nephelometric Turbidity Units (NTU) or Jackson Turbidity Units (JTU)

[g] BLM surface water gauging station

3.5.2.3 Waters of the U.S.

The majority of the surface water resources within the Project Area are considered waters of the U.S. This category includes territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams); special aquatic sites and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of these waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (33 CFR 328.3(a)). These areas are regulated by the EPA and COE. Many of the drainage channels identified on the USGS topographic maps are vegetated swales that are not considered to be waters of the U.S. Any activity that involves excavation or discharge of dredge or fill material in a manner that affects waters of the U.S. is subject to regulation by the COE pursuant to Section 404 of the Clean Water Act (CWA). Activities that modify the morphology of stream channels are also subject to regulation by the WSEO.

3.6 VEGETATION, WETLANDS AND NOXIOUS WEEDS

3.6.1 Vegetation and Cover Types

A biological survey of the Project Area was conducted in 2000 and 2001 (HWA 2002). The Project Area is located in the sagebrush steppe plant community that is typical of the high intermountain desert of south-central Wyoming. The primary vegetation cover type of the Project Area is Wyoming big sagebrush, as identified as part of the Wyoming Gap Analysis Program (GAP) (HWA 2002). The Wyoming big sagebrush cover type typically consists of a mixture of greasewood, Wyoming big sagebrush, rabbitbrush and saltbush, with interspersed mixed grasses. In 1987, a prescribed burn was conducted on the southeast flank of Doty Mountain, affecting approximately 400 acres within the Project Area. Shrub cover in the Project Area averages between 5 and 10 percent. Common species in this plant community in addition to big sagebrush include: Douglas and rubber rabbitbrush, cotton horsebrush, black greasewood, snowberry, western and bluebunch wheatgrass, Indian ricegrass, needle and thread, mutton and little bluegrass, basin wildrye, bottlebrush, squirreltail, phlox, buckwheat, penstemon, onion, sego lily, miner's candle, Indian paintbrush, and violet.

To enhance the general vegetation information provided above, a field reconnaissance of the Project Area was conducted on September 17-18, 2003, as part of this analysis. Existing vegetation within the proposed disturbance areas was observed and recorded.

The vegetation community type in the proposed disturbance area is generally sagebrush/grassland. Typically two integrading varieties of sagebrush occur in the Project Area and tend to occupy distinctive habitats. Wyoming sagebrush typically is found in the more xeric uplands, while big sagebrush is found in the more mesic narrow valley bottoms. Wyoming sagebrush is distinguished from big sagebrush by its short growth form and regular canopy. In some location along broader alluvial-filled valleys and toe-slopes, the shrub canopy is absent and a grass canopy predominates. The dominant grass is Prairie junegrass, with species of wheatgrass and Indian ricegrass occurring less frequently.

Within the sagebrush/grassland community type, Rubber rabbitbrush, broom snakeweed, and Gray horsebrush are common and snowberry is rare. Black greasewood is generally uncommon but is often a dominant component of the shrub canopy along valley terraces and toe-slopes where shale and saline soils are prevalent. Common herbaceous forbs include species of buckwheat flower and lupine and, to a lesser degree, species of phlox. Antelope bitterbrush occurs rarely to infrequently in the Project Area.

3.6.2 Threatened and Endangered Species

According to the FWS (2000) and the Wyoming Natural Diversity Database (WYNDD), the only federally listed plant species that has the potential to occur near the Project Area is blowout penstemon (*Penstemon haydenii*). While there is potential for the species to exist, no plants have been found in the project area. Blowout penstemon is federally endangered (HWA 2002). No other threatened or endangered plant species are expected to occur near the Project Area.

Blowout Penstemon. Blowout penstemon is a member of the snapdragon family. The species is most commonly found in the bowls and along the rims of sandy blowouts (HWA 2002). In Wyoming, the species has been documented on very steep, unstable sand dunes (HWA 2002). Within these limited habitats, blowout penstemon typically occurs in large, multi-stemmed clumps. When in bloom, its lavender-purple flowers stand out against other sparse vegetation found in and around sandy blowouts. In addition to the features of its leaves and flowers, blowout penstemon's lavender or vanilla-like fragrance is a characteristic that distinguishes it from other *Penstemon* species. Blowout penstemon typically blooms between late May and late June. This short flowering period is the best time of year to survey for the species.

A large area of sand dunes and blowouts exists in and around the Sandhills area about 1 to 3 miles southeast of the Project Area. This area may provide potential habitat for blowout penstemon, however, the species was not found during field surveys of this area conducted by the WYNDD in June of 2000 (HWA 2002). Very small and limited areas of sandy blowouts may occur near the Project Area, however, blowout penstemon was not found in the Sandhills area and is, therefore, unlikely to occur in the Project Area. The nearest documented population of blowout penstemon is located just south of the Ferris Mountains approximately 58.0 miles to the north of the Project Area (HWA 2002).

3.6.3 Species of Concern

Species of concern include candidates for federal listing under the Endangered Species Act (ESA), BLM special status species (BLM 2001), Wyoming Game and Fish Department (WGFD) special concern species, and species that are designated rare by The Nature Conservancy and the WYNDD. Species that have not been listed as endangered or threatened by the FWS, but have been identified for possible listing in the future, are classified as candidate species.

Seven plant species of concern may occur within or near the Project Area, of which Gibben's beardtongue has the highest priority for conservation (HWA 2002, HWA 2003). Four of the species are unlikely to occur in or near the Project Area because the habitat types required are not present. The remaining three special concern plant species have low to moderate potential to occur in or near the Project Area. Appendix E provides information on all seven species of concern, including sensitivity status, range, and distribution within Wyoming, probability of occurrence in the Project Area, and descriptions of the habitat where the plants are found.

3.6.4 Wetlands

No special aquatic sites or wetlands have been identified in or near the Project Area, including the lateral sales pipeline route; therefore, these resources were not analyzed further. The nearest potential riparian habitat is located along Dry Cow Creek, southwest of the Project Area.

3.6.5 Noxious Weeds and Invasive Species

The Project Area is vulnerable to infestations of noxious weeds species such as Canada thistle, musk thistle, Russian knapweed and whitetop and invasive species such as black henbane, halogeton and cheatgrass. Based on field reconnaissance conducted on September 17-18, 2003 as a part of this analysis, noxious weeds and invasive species are components of the vegetation community within the proposed disturbance areas of the Project Area and are discussed below.

Spotted or Russian knapweed was observed rarely to infrequently in the northeast quarter of Section 22 in T17N R91W. Both of these species are listed on the Wyoming Weed and Pest Control Designated List.

Cheatgrass, cactus and shephard’s purse, or species of cress, are frequent to abundant in heavily grazed portions of the Project Area.

3.7 RANGE RESOURCES AND OTHER LAND USES

3.7.1 Range Resources

Agriculture (primarily grazing use by cattle, horses, or sheep) is a primary land use in the Project Area. The Project Area is entirely located within the Doty Mountain Allotment (#00415) managed by the BLM RFO in accordance with the Great Divide RMP. The Doty Mountain Allotment includes 84,008 acres (about one-third private) and supports 15,295 animal unit months (AUMs). It is used as a cow-calf operation with the base ranch located in Baggs. About two-thirds of the range is considered in good condition; the remainder is either in excellent, fair, or undetermined condition, with less than 1 percent of the range considered in poor condition. The average stocking rate for the Doty Mountain Allotment is 12 acres per AUM.

The season of use for the allotment is from April 1 to December 31. The Project Area lies within the summer pasture of the Doty Mountain Allotment, where cattle use is rotated within a nine-pasture system. The summer pasture is used from about mid-June through mid-September, which defers the growing season for most plant species. The water sources for livestock use in this pasture are numerous small reservoirs and two water wells. Some of the water sources for this pasture, 5 reservoirs and 1 well, are located within the Project Area. Water is occasionally limited within this summer pasture.

3.7.2 Other Land Uses

The Project Area contains an estimated 1,282 acres of federal surface ownership lands in Sections 14, 22, 28, and 32, T17N R91W; Section 6, T16N R91W; and Sections 1 and 12, T16N R92W. These public lands are open for public use, and are administered by the RFO in accordance with the Great Divide RMP. Within the Project Area, privately owned lands are located in Sections 15 and 23, T17N R91W, and Sections 27, 29, T17N R91W. The State of Wyoming owns Section 36 of T17N R92W, located just west of the Project Area.

Other uses within and adjacent to the Project Area include wildlife habitat; oil and gas exploration, development, and transmission; and dispersed outdoor recreation (primarily hunting in the fall). No facilities for developed recreation exist within the Project Area.

3.8 WILDLIFE AND FISHERIES

3.8.1 Wildlife

The Project Area includes 1,520 acres of sagebrush steppe wildlife habitat. Another 400 acres of sagebrush steppe habitat was burned in 1987 on the southeast flank of Doty Mountain within the Project Area. Shrub cover on these sites averages between 5 and10 percent. Common species in this plant community in addition to big sagebrush include: Douglas' and rubber rabbitbrush, cotton horsebrush, black greasewood, snowberry, western and bluebunch wheatgrass, Indian ricegrass, needle and thread, mutton and little bluegrass, basin wildrye, bottlebrush squirreltail, phlox, buckwheat, penstemon, onion,

sego lily, miner's candle, Indian paintbrush, and violet. Many common species of birds, mammals, amphibians, and reptiles may be found within the Project Area. The proposed project is not expected to significantly alter the common species found in the Project Area; therefore, they were not specifically discussed in this analysis. The existing threatened, endangered, candidate and species of concern, as well as big game species, raptors, and greater sage grouse in the Project Area, are discussed in detail. The area of interest for wildlife concerns encompasses the Project Area and the proposed road access/pipeline route with a 2-mile buffer for greater sage grouse leks, and a 1-mile buffer for raptor nests. Wildlife surveys discussed and summarized here were conducted as part of the broader-scale surveys performed in 2000 and 2001.

Greater sage grouse habitat data, seasonal big game range designations, and raptor nest locations were obtained from the habitat data in WGFD's Wildlife Observation System (WOS). Additional information on raptors was obtained from BLM's raptor nest database (Jackson 2003). WGFD big game herd unit annual reports were used for herd unit population statistics. This existing wildlife information for the Project Area was supplemented through survey data collected in 2000 and 2001 (HWA 2003). Data were collected through a series of aerial and ground surveys to: (1) determine the occurrence, location, and size of white-tailed prairie dog colonies; (2) determine the location and activity status of raptor nests; (3) search for previously undocumented greater sage grouse leks and determine the activity status of all leks in the area; (4) locate winter concentration areas for greater sage grouse; and (5) record incidental observations of BLM sensitive species.

3.8.1.1 Big Game

Three big game species, pronghorn antelope, mule deer, and elk, occur within or may use the Project Area. The types of big game seasonal ranges designated by WGFD are winter, winter/yearlong, and crucial winter range. Winter ranges are used by substantial numbers of animals only during the winter (December through April). Winter/yearlong ranges are occupied throughout the year, but are also used by other species that migrate from other seasonal ranges.

Pronghorn Antelope. The Project Area is located within the 1,394-square-mile Baggs Herd Unit. The Project Area is designated as pronghorn winter/yearlong range (2,080 acres). Pronghorn likely migrate through the northern portion of the Project Area toward crucial winter/yearlong range located northwest of the area (HWA 2002). The 2001 post-hunt season population estimate for the Baggs Herd Unit was 6,800 animals, which is 9 percent higher than the population average of 6,240 animals estimated for 1996 through 2000. The population objective was increased by 25 percent in 1994, from 7,200 to 9,000. The population estimate of 6,240 for 1996 through 2000 was 24 percent below the WGFD management objective. According to HWA (2002), the Baggs pronghorn herd had experienced low fawn production, resulting in slow growth, but production has improved during recent years and the population appears to be rebounding. The Project Area is located within Hunt Area 53, where the hunter success rate for 2001 was 98.1 percent.

Mule Deer. The Project Area is located within the Baggs Herd Unit. The Baggs Herd Unit is large (3,440 square miles) and contains habitats ranging from subalpine to montane coniferous forests to desert scrub. The Project Area is designated as winter/yearlong mule deer range (2,080 acres). No major migration routes for mule deer across the Project Area were identified (HWA 2002). The post-hunt population estimate for the Baggs Herd Unit was 18,000 in 2001 (HWA 2002). This estimate is slightly below the WGFD management objective of 18,700. The Project Area is located within Hunt Area 82, where the hunter success rate for 2001 was 42.6 percent.

Elk. The Project Area is located within the Sierra Madre Herd Unit (2,425 square miles). Most elk in the herd unit use spring/summer/fall ranges in the Sierra Madre Mountains, although groups use habitats on Atlantic Rim and around McCarty Canyon. During winter, the elk migrate to winter range habitats at lower elevations on the western side of the Sierra Madre Mountains and into the Atlantic Rim and Sand Hills areas. Some animals may migrate as far west as the Powder Rim, located 40 miles west of Baggs (HWA 2002). No major elk migration routes across the Project Area were identified (HWA 2002). Habitats in the Project Area are designated as elk winter range (2,080 acres). The 2001 post-hunt season population estimate for the Sierra Madre Herd Unit of 5,500 animals is 31 percent above the WGFD management objective of 4,200. The Project Area is located within Hunt Area 21, where the hunter success rate for 2001 was 36.5 percent.

3.8.1.2 Upland Game Birds

Greater Sage Grouse. The Project Area is located within the extensive sagebrush and grassland habitats of south-central Wyoming, where greater sage grouse are common. Strutting grounds (leks), nesting, brood-rearing, and wintering habitats are all important components required by greater sage grouse. This habitat can occur as contiguous or in a patchy, disconnected pattern (HWA 2002). Preferred nesting habitat is usually located within 2 miles of leks (HWA 2002). The greater sage grouse is not formally listed as threatened or endangered, but it is a BLM sensitive species and it receives special consideration because its population is declining over much of its range.

The Project Area is located within the Sierra Madre upland game management unit area (Area 25). According to the Annual Report of Upland Game and Furbearer Harvest for 2001, 761 greater sage grouse were harvested in Area 25, providing 724 hunter recreation days (HWA 2002). In 2001, the Sierra Madre Upland Game Management Area accounted for approximately 6 percent of the statewide harvest of greater sage grouse (761 out of 12,742 birds taken).

The Project Area is covered by habitats dominated by sagebrush. Because greater sage grouse use sagebrush habitats all year, the area provides excellent year-round range. Aerial surveys were conducted during the winter in 2001 to identify and define greater sage grouse concentration areas. The Atlantic Rim area, including the Project Area, was surveyed on February 17 to 18, 2001. Snow cover during that winter was much deeper than normal. The deep snow cover forced greater sage grouse to seek out habitats with tall sagebrush. During spring and summer in 2001, each location where greater sage grouse were observed during the winter survey was visited during a ground survey, and habitat used by greater sage grouse was mapped. Habitat patches located from the air were re-

fined by walking the perimeter and recording UTM coordinates with a handheld GPS unit. Sagebrush in the winter use areas was usually located in long linear patches in drainage bottoms and was between 2 and 4 feet tall. These habitat areas are referred to as crucial or severe winter relief habitat (HWA 2003).

Aerial surveys were also conducted by HWA biologists during late March and early April in 2001 to check the status of known sage-grouse leks and document new leks. Although no active sage-grouse leks were documented within the Project Area during the 2001 aerial survey, three active leks occur within 2 miles of the Project Area (Figure 3-1). The overlapping 2-mile buffers around the two leks located southwest of the proposed project include about 540 acres within the Project Area. The proposed lateral pipeline and associated road intersect about 4.9 miles of potential sage-grouse nesting habitat within the 2-mile buffers of the two leks. One active sage-grouse lek was located less than 2 miles from the southeastern corner of the Project Area (Figure 3-1). The 2-mile buffer around this lek includes about 96 acres of the Project Area, in which the construction of one well is proposed.

3.8.1.3 Raptors

Species of raptors that may occur in the Project Area include golden eagle, bald eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, American kestrel, merlin, prairie falcon, peregrine falcon, short-eared owl, long-eared owl, great-horned owl, and burrowing owl. Helicopter surveys of raptor nests located in and around the Project Area were conducted during late May 2001 (HWA 2003). The helicopter survey protocol consisted of flying low-level transects at ½-mile intervals within a 1-mile buffer zone of each area. Areas of potential raptor nest habitat (such as cliffs and rock outcrops) were surveyed more intensively. Locations of nests were recorded with a GPS unit. No raptor nests (active or inactive) were located within the POD boundary. One inactive ferruginous hawk nest and one inactive golden eagle nest were located within 1 mile of the Project Area (HWA 2003).

Fifteen additional inactive ferruginous hawk nests and two inactive red-tailed hawk nests were located within one mile of the proposed access road and the proposed lateral pipeline (HWA 2003, Jackson 2003).

3.8.2 Special Status Species - Wildlife and Fish

3.8.2.1 Wildlife Species

Surveys for species that are federally listed as threatened, endangered, candidate, or species of concern were conducted in 2000 and 2001 as part of larger-scale surveys being performed in support of the Atlantic Rim Natural Gas Project EIS (HWA 2003). The area of interest for threatened, endangered, candidate and species of concern (Appendix E) includes the Project Area and a 1-mile buffer for raptor nests. In addition, the proposed route for the lateral pipeline and access road that would run approximately 7.1 miles southwest from the compressor station in T17N R91W, Section 23 to the existing

pipeline in T16N R92W, Section 12 is also considered. Locations for threatened and endangered species were obtained from the WOS.

Data were collected through a series of aerial and ground surveys to: (1) determine occurrence of threatened, endangered, proposed, or candidate species for listing in the Project Area; and (2) determine the occurrence, location, and size of mountain plover habitat and conduct a preliminary presence/absence survey for the species.

3.8.2.2 Threatened and Endangered Species – Wildlife and Fish

3.8.2.2.1. Wildlife Species

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies. The original distribution of the black-footed ferret in North America closely corresponded to the distribution of prairie dogs (HWA 2002). In Wyoming, white-tailed prairie dog colonies provide habitat for black-footed ferrets. Ferrets depend almost exclusively on prairie dogs for food, and they use prairie dog burrows for shelter, parturition, and rearing their offspring (HWA 2002).

Aerial surveys of prairie dog colonies were conducted over the Project Area between March 26 and April 3, 2001 (HWA 2003). Linear transects (¼-mile spacing) were flown using a fixed-wing aircraft with GPS capabilities at an average altitude of 200 feet. Prairie dog colonies were observed from the air, and the approximate center of each town was recorded as a single GPS point. Prairie dog towns located from the air were mapped on the ground using a handheld GPS and an all-terrain vehicle (ATV) between June 6 and June 27, 2001. One small prairie dog colony, approximately 4 acres in size, was located within the Doty Mountain POD boundary.

Canada Lynx. Records of lynx in Wyoming indicate that most lynx or lynx sign between 1973 and 1986 were in lodgepole pine (18 percent) and spruce-fir (41 percent) communities. More than 50 percent of lynx records occurred in the northwestern region of the state (HWA 2002). The nearest records of lynx to the Project Area were from the Medicine Bow River in 1856 (HWA 2002). Since then, no lynx sightings or sign have been documented in Carbon County.

It is unlikely that lynx occur in or near the Project Area because (1) the Project Area does not include high-elevation lodgepole pine/spruce-fir habitat types preferred by this species; (2) the Project Area does not support a population of snowshoe hares (preferred prey); (3) there are no recorded lynx sightings near the Project Area (HWA 2002); and (4) the closest potential habitat is more than 10 miles away in the Sierra Madre Mountains.

Figure 3-1 Wildlife and Sensitive Species

Bald Eagle. Primary wintering areas for the bald eagle are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available, and near ungulate winter ranges that provide carrion (HWA 2003). Wintering bald eagles are also known to roost in forests with large, open conifers and snags that are protected from winds by ridges, often near concentrations of domestic sheep and big game (HWA 2003).

Incidental sightings of bald eagles have been recorded near the Project Area (HWA 2003). Most observations were documented between November and March, indicating that the area is used by bald eagles during the winter. No communal winter roosts are known to exist in or near the Project Area. Inspection of BLM and WGFD raptor nest records and results of aerial and ground raptor nest surveys revealed that no bald eagle nests occur within a 2-mile buffer of the Project Area. The closest known nest is located approximately 30 miles southwest of the Cow Creek POD, another exploratory project of the Atlantic Rim Interim Drilling Project (HWA 2003).

Bald eagles typically build stick nests in the tops of large coniferous or deciduous trees along streams, rivers, or lakes. These types of habitats are not present in the Project Area; therefore, bald eagles are not expected to nest there. Bald eagles may use the Project Area during the winter, when big game species are more concentrated on winter ranges. However, the Project Area does not support concentrated use by bald eagles, and bald eagle use is likely incidental.

3.8.2.2.2. Fish Species

Four federally endangered fish species may occur as residents of the Little Snake River system downstream of the Project Area. These species are the Colorado pikeminnow, bonytail, humpback chub, and razorback sucker (FWS 2003). The last sighting of any of these fish in the Little Snake River was of a single Colorado pikeminnow in 1990. The lack of perennial waters within the Project Area and for several miles downstream precludes potential for the occurrence of the four species of endangered fish within the Project Area (HWA 2003). Although highly unlikely, any of these fish species may occur in Muddy Creek outside of the Project Area or farther downstream in the Little Snake River or Yampa River on a seasonal basis for spawning and/or rearing. Currently, it is not known whether suitable spawning, age-0, or juvenile habitats for any of these species may still be present in the waters downstream from the Project Area. To date, critical habitat for these fish species has not been designated anywhere in Wyoming (HWA 2003).

3.8.3 Species of Concern - Wildlife and Fish

3.8.3.1 Wildlife Species

Species of concern include candidates for federal listing under the ESA, BLM special status species (BLM 2001), WGFD special concern species, and species that are designated rare by The Nature Conservancy and the WYNDD. Species that have not been listed as endangered or threatened by the FWS, but have been identified for possible listing in the future, are classified as candidate species.

3.8.3.1.1. BLM State Sensitive Species Found in the Rawlins Field Office Management Area

Six mammal species of concern, 16 bird species of concern, 3 amphibian species of concern, and 4 fish species of concern may occur in or near the Project Area (HWA 2002, HWA 2003). Appendix E provides information on all 28 wildlife and fish species of concern including sensitivity status, range, and distribution within Wyoming, probability of occurrence in the Project Area, and habitat descriptions.

3.8.3.1.2. Mammals

Six BLM Wyoming state sensitive mammal species are found in the RFO area (BLM 2002). These species include Wyoming pocket gopher, white-tailed prairie dog, swift fox, fringed myotis, long-eared myotis, and Townsend's big-eared bat. Only one of these species, the white-tailed prairie dog, is known to occur in the Project Area; one small colony (4.0 acres) exists in the northwest quarter of Section 23. The Wyoming pocket gopher and swift fox are likely to occur in the Project Area. The remaining species (fringed myotis, long-eared myotis, and Townsend's big-eared bat) have a slight potential to occur in the Project Area (HWA 2003).

3.8.3.1.3. Birds

Sixteen BLM Wyoming state sensitive bird species are found in the RFO area (BLM 2002). These species include mountain plover (discussed separately below), Baird's sparrow, sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, yellow-billed cuckoo, loggerhead shrike, Columbian sharp-tailed grouse, greater sage grouse, white-faced ibis, trumpeter swan, peregrine falcon, ferruginous hawk, and northern goshawk. The western subspecies of yellow-billed cuckoo is considered a FWS candidate for listing as endangered. Species known to be present in the Project Area include: sage sparrow, sage thrasher, loggerhead shrike, greater sage grouse, and ferruginous hawk. Two of these species, western burrowing owl and Colombian sharp-tailed grouse may occur in the Project Area. Colombian sharp-tailed grouse have been documented in the Sand Hills area just east of the Project Area (Blomquist 2003), and western burrowing owls are known to utilize prairie dog colonies for nesting and rearing sites. Five species, including Baird's sparrow, long-billed curlew, yellow-billed cuckoo, white-faced ibis, and trumpeter swan, are unlikely to occur. Brewer's sparrow, peregrine falcon, and northern goshawk have a slight potential to occur in the Project Area (HWA 2003).

Mountain Plover. The mountain plover nests over much of Wyoming, but its preferred habitat is limited throughout its range (HWA 2003). This ground-nesting species is typically found in areas of short vegetation (less than 4 inches) on slopes of less than 5 percent. Any short grass, very short shrub, or cushion plant community could be considered plover nesting habitat (HWA 2003); however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling areas dominated by blue grama and buffalograss (HWA 2003). Loss of wintering and breeding habitats and declines in the prey from pes-

ticide use are thought to be factors contributing to the decline of mountain plovers on the North American continent (HWA 2003).

The Atlantic Rim EIS study area was surveyed for mountain plover habitat in May 2001 (HWA 2003). Areas with habitat that meet the habitat requirements for mountain plovers discussed above were identified on the ground and mapped on 1:24,000 scale topographic maps. In order to not overlook any potential mountain plover habitat, habitat was conservatively classified including some areas with slopes greater than 5 percent and vegetation taller than 4 inches. These areas were termed potential mountain plover habitat.

3.8.3.1.4. Amphibians

Three BLM Wyoming state sensitive amphibian species are found in the RFO area (BLM 2002). These species include boreal toad, Great Basin spadefoot toad, and northern leopard frog. The Great Basin spadefoot toad has a slight potential to occur, and the boreal toad and northern leopard frog are unlikely to occur in the Project Area (HWA 2003).

3.8.3.2 Fish Species

Four BLM Wyoming state sensitive fish species may occur in Muddy Creek within the Project Area and immediately downstream of the Project Area in Muddy Creek and the Little Snake River. These fish include roundtail chub, bluehead sucker, flannelmouth sucker, and Colorado River cutthroat trout (HWA 2003).

3.9 RECREATION

Hunting, camping, and off-road vehicle (ORV) use are the most popular recreational activities in or near the Project Area, although no developed recreational sites, facilities, or special recreational management areas exist within or adjacent to the Project Area. The majority of recreation is associated with the fall hunting seasons, specifically during September and October for the greater sage grouse. Pronghorn hunting also occurs in September, and other hunting use occurs during the mule deer season in mid-to-late October. Rabbits and some predators are hunted during the fall and winter. Outside the hunting seasons, the area attracts small numbers of visitors who engage in rock collecting, camping and hiking, observing wildlife, outdoor photography, and picnicking. Although data on recreational visitation are not available, overall use levels are generally low (BLM 2000). Low visitation to the Project Area is a result of the small number of local residents, the long drives from major population centers, lack of publicized natural attractions, and road conditions that limit access by vehicles into many areas.

3.10 VISUAL RESOURCES

The Project Area is typical of the more rugged sections of Wyoming Red Desert region: lands in the Project Area are moderately undulating. Numerous small drainages dissect the landscape, providing topographic diversity. The visual resource management (VRM) class of the Project Area is Class III, which includes areas where changes in the basic elements (form, line, color, or texture) caused by management activities may be evident

in the characteristic landscape. The objective of this class is to provide for management activities that may modify the existing character of the landscape. However, changes should remain subordinate to the visual strength of the existing character.

Larger views that encompass several viewsheds are available from high points. The expansive panorama dominated by the horizon between sky and land is a significant aspect of all distant views. The predominant vegetation types, typical of cold desert steppe, are alkali and low sagebrush, mixed desert scrub, and grasses and forbs, with scattered patches of big sage/rabbit brush on flatter north- and east-facing slopes, along drainage ways, and in large depressions. Small, established stands of juniper also grow within the Project Area. The combination of plant communities creates a subtle mosaic of textures and colors. Predominant vegetation colors in early spring are green and gray green, changing to gray/green and buff/ochre as grasses and forbs cure in the summer and fall. Reddish brown and buff colors of the badland formations add contrast and dominate in areas of steep topography.

Evidence of cultural modification in and near the Project Area includes unimproved roads and some oil and gas production facilities. Motorists traveling WY 789 would not have visual access to the Project Area because of the viewing distance (3 to 6 miles) and intervening elevated topography. However, facilities and activities located on ridgelines or buttes would be visible over longer distances. The quality of the visual resource is an important part of the recreational experience for many users. Other non-recreational users of the area, including grazing permit holders and those working in the oil and gas industry, may also be affected by changes to the visual landscape.

3.11 CULTURAL RESOURCES

3.11.1 Culture History

The earliest known period of culture history in southwestern Wyoming is that of Paleoindian beginning about 12,000 years before present (B.P.), which has come to signify hunting and gathering adaptations of late Pleistocene and early Holocene age. The hunting and butchering of megafaunal animals such as mammoths and bison characterize this period. At these sites large, lanceolate projectile points are often found in association with the skeletal remains of the now extinct megafauna.

Following the Paleoindian period is the Archaic period. The Archaic period dates from about 8,500 to 2,000 years B.P. During this time, groups adopted a more varied hunting and gathering subsistence pattern. In southwestern Wyoming, recent investigations reveal a subsistence system with an emphasis on plant processing and small game. The Early Archaic period is also marked by a change in projectile point technology from lanceolate types to side-notched dart points. The Archaic period in the Washakie Basin is divided into Early and Late periods. The Early period is subdivided into the Great Divide and Opal phases. The Middle Archaic period is represented in other areas of the southwest Wyoming and is known as the McKean complex. The subsistence economy remained much as it had been during the Early Archaic period with both hunting and gathering activities in evidence. By 3,000 years before present, new cultural manifestations

replaced the McKean complex. The first of these is Pelican Lake, known for its corner-notched projectile points. In the Wyoming Basin, Elko series points are also relatively common during this time. In the Waskakie Basin, the chronology goes from the Early Archaic to a Late Arachaic. The Late Archaic is subdivided into the Pine Spring and Deadman Wash phases. The subsistence economy remained much as it had been during the Early Archaic period.

The Late Prehistoric period 2,000 B.P. is subdivided into the Uinta and the Firehole phases in the Washakie Basin and is marked by the introduction of bow and arrow and pottery. Small side- and corner-notched projectile points including the Desert side-notched and Rose Springs types appear at this time. With the exception of the bow and arrow and ceramics, there was little change in the material culture or in life ways over the preceding Archaic periods. The Protohistoric period is marked by the introduction of the horse and European trade goods. The horse and gun allowed some tribes to concentrate intensely on bison hunting. The influx of European technology also changed patterns of trade and migration among groups. In some instances, the social and economic organization shifted from small family bands to larger, more permanent groups of several families. Southwestern Wyoming in the Historic period has predominately been used for cattle and sheep ranching. Fur trapping and trading was not an important occurrence in the project area due to lack of perennial streams. There are historic trails and transportation routes such as the Overland Trail, Cherokee Trail, Outlaw Trail, and Baggs to Wamsutter Road that are important corridors which occur near the Project Area. Settlement has been limited due to scarce water sources and rugged terrain.

The accepted cultural chronology of the Washakie Basin is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The prehistoric and historic chronology is documented in Tables 3-10 and 3-11.

3.11.2 Cultural Environment

The Washakie Basin is an area that has been heavily dissected by the tributary drainages of Dry Cow Creek and Muddy Creek. Landforms consist of ridges, finger ridges, knolls, and hills. Stabilized, intermittent sand dunes occur in hilly upland areas. Eolian sands from western sources add an additional component to localized soils. In southwest Wyoming, sand deposits (dunes, shadows, and sheets) are recognized as highly likely to contain cultural material.

TABLE 3-10 PREHISTORIC CHRONOLOGY OF THE WYOMING BASIN

Period	Phase	Age (B.P.)
Paleoindian		12,000 – 8,500
Early Archaic	Great Divide	8,500 – 6,500
	Opal	6,500 – 4,300
Late Archaic	Pine Spring	4,300 – 2,800
	Deadman Wash	2,800–2,000/1,800
Late Prehistoric	Uinta	2,000/1,800 – 650
	Firehole	650 – 300/250
Protohistoric		300/250 – 150

Source: Metcalf (1987), as modified by Thompson and Pastor (1995)

TABLE 3-11 HISTORIC CHRONOLOGY OF THE WASHAKIE BASIN

Phase	Age A.D.
Pre-Territorial	1842 – 1868
Territorial	1868 – 1890
Expansion	1890 – 1920
Depression	1920 – 1939
Modern	1939 – Present

Source: Massey 1989

Prehistoric use of the Washakie Basin reflects a hunter-gatherer lifestyle. Research into the subsistence and settlement patterns during the Archaic period indicates summer occupations in the mountains, winter occupations in the foothills, and spring and fall movements that made use of all available zones (Creasman and Thompson 1997). Subsistence patterns in the Archaic and the Late Prehistoric periods are similar in that they are based on seasonal movement throughout the basins and foothills in response to the availability of floral and faunal resources (Creasman and Thompson 1997). The topographic setting is conducive to prehistoric occupation. A high potential for prehistoric sites occurs near reliable water sources such as Dry Cow Creek and Muddy Creek. As distance increases from these water sources, site density drops.

Historical use of the Washakie Basin area was affected by the formidable topographic relief. Steep canyons, badlands, and escarpments made the area more difficult for settlement. The area was primarily used for cattle and sheep ranching. Limited ranching is identified by the presence of historic debris scatters and the historical record.

3.11.3 Summary of Cultural Resources

Previous fieldwork was identified during the Class I file searches requested from the Wyoming Cultural Records Office for the surveys (Hatcher 2001; 2003a; 2003b). A considerable amount of fieldwork has occurred near the Project Area, resulting in the documentation of cultural resources through survey, examination of ethnographic records, and research of historic records. No sites have been extensively tested or excavated in the Project Area. However, several sites have been excavated in the surrounding area, contributing data about the prehistory and history of the area.

3.11.3.1 Previous Surveys

Previous surveys have been conducted in the vicinity of the Project Area. This includes Class II and Class III surveys. Table 3-12 summarizes the previous work in or adjacent to the Project Area by township, range and section.

TABLE 3-12 PREVIOUS CULTURAL RESOURCE INVENTORIES IN THE VICINITY OF THE PROJECT AREA

T/R/Sec	Survey Qty	Survey Type	Sites/Isolated Finds
16N/91W/6	2	Class III	5 sites
16N/92W/1	3	Class III	2 sites
16N/92W/12	21	Class III	4 sites
17N/91W/14	1	Class II/Class III	1 site
17N/91W/22	2	Class II/Class III	0
17N/91W/23	0	No survey	0
17N/91W/27	0	No survey	0
17N/91W/28	0	No survey	0
27N/91W/29	1	Class III	0
27N/91W/31	2	Class III	10 sites
17N/91W/32	2	Class II/Class III	7 sites
Total	**34**		**29 sites**

3.11.3.2 Previously Recorded Sites

Previous cultural resource inventories documented 29 sites and no isolated finds within or adjacent to the Project Area. Table 3-13 summarizes 9 sites that are located within the Project Area or within ¼ mile of the boundary. The table lists each site by type and eligibility for the NRHP. There are 7 prehistoric sites and 2 historic sites. The seven prehistoric sites include two eligible, two not eligible, and three with unknown eligibility for the NRHP. The two historic sites include one eligible and one not eligible for the NRHP. Two of the sites are within the Project Area but could not be relocated during the 2001 and 2003 investigations.

TABLE 3-13 PREVIOUS CULTURAL RESOURCE INVENTORIES

Period	Site Type	Site Number	Eligibility
Prehistoric Sites			
	Lithic Scatter	48CR389	ENL
		48CR1322	NE*
		48CR7823	Unk*
	Lithic Scatter w/features	48CR1078	E*
		48CR1318	E*
		48CR1321	NE*
	Open Camp	48CR7821	Unk*
Historic Sites			
	Artifact Scatter	48CR1320	NE*
	Sheepherder Camp	48CR1334	E

ENL = Eligibility Not Listed; NE = Not Eligible; Unk = Unknown; E = Eligible; * indicates sites outside of the Project Area but within ¼ mile.

Site 48CR389 is a prehistoric lithic scatter. There is no eligibility listed for this site. The site is within the Doty Mountain POD boundary. The 2003 investigation could not relocate the site.

Site 48CR1334 is a sheepherder's camp that is recommended as eligible by the field archaeologist but not reviewed by the SHPO. The site is within the boundaries of the Project Area. The site was not relocated during the 2001 survey.

3.11.3.3 Potential Site Types

Based on the results of the files searches, the expected cultural resources for this area include prehistoric and historic resources. The prehistoric and historic site types are:

- Prehistoric open camps that contain evidence of a broad range of activities, including subsistence-related activities. Cultural remains include features, lithic debris, chipped stone tools, and depending on the temporal period of use, evidence of milling and vegetable processing, including ground stone and pottery.

- Prehistoric lithic scatters consist of lithic debris such as debitage or chipped stone tools.

- Prehistoric or historic cairns that are low piles of local stone. Historic cairns are often constructed by sheepherders.

- Historic artifact scatters that are collections of historic debris often left by sheepherders and consist of artifacts such as glass, ceramic, and cans.

Other site types that could occur but that have not been recorded in the Project Area include:

- Prehistoric quarries that are areas where lithic raw material was obtained and initially processed.

- Human burials, rock art (both pictographs and petroglyphs), and rock alignment could occur and may be identified as sensitive or sacred to Native Americans. Few of these types of sites have been located in southwestern Wyoming.

3.11.3.4 Cultural Resource Inventories for the Project

The Project Area was intensively surveyed in 2001 and 2003 (Hatcher 2001; 2003a; 2003b). Those investigations resulted in the recording of four new sites. One site is historic and three are prehistoric. The three prehistoric sites are recommended eligible for inclusion in the NRHP.

Site 48CR7617 is a historic cairn. It is constructed of locally occurring sandstone slabs. Cairns, similar to this one, are common in the area and were often constructed by sheepherders. This site is recommended as not eligible for inclusion in the NRHP.

Site 48CR7956 is a prehistoric open camp with lithic debitage and a hearth feature. Fire altered stone was also observed. The site has the potential for buried *in situ* cultural re-

mains and is recommended as eligible for inclusion in the NRHP based on the site's information potential.

Site 48CR7960 is a prehistoric open camp with a chipped stone tool, lithic debitage, and a possible hearth feature. The site has the potential for buried *in situ* cultural remains and is recommended as eligible for inclusion in the NRHP based on the site's information potential.

Site 48CR7961 is a prehistoric site, possibly an open camp. The site consists of lithic debitage and a possible hearth. The site has the potential for buried *in situ* cultural remains and is recommended as eligible for inclusion in the NRHP based on the site's information potential.

3.11.4 Conclusion

The recent cultural inventory of the Project Area identified 29 previously recorded sites, 3 newly recorded prehistoric sites, 1 historic site, and no isolated finds. There are 20 sites that are greater than ¼ mile from the Project Area. Of the remaining 12 sites that are in or within ¼ mile, 10 are prehistoric sites with 5 eligible, 2 not eligible, and 3 with unknown eligibility for the NRHP and 3 are historic sites with one eligible for the NRHP. Six of the sites are within the Project Area and six are outside the Project Area. Two of the previously recorded sites within the current boundary of the Project Area could not be relocated.

In southwest Wyoming, sand deposits (dunes, shadows, and sheets) are recognized as highly likely to contain cultural material. Certain topographic settings have greater archaeological sensitivity including eolian deposits (sand dunes, sand shadows, and sand sheets), and to a limited degree, colluvial deposits along lower slopes of ridges. The Project Area includes these deposits. Proximity to reliable water sources such as Dry Cow Creek and Muddy Creek is an important factor in predicting the occurrence of prehistoric resources and usually results in a high potential for prehistoric sites. If the proposed action were modified, an additional cultural resources inventory for the new area of proposed disturbance would be required.

3.12 SOCIOECONOMICS

The geographic area of analysis for potential socioeconomic effects is Carbon County, Wyoming, and the nearest established communities of Baggs, Dixon, and Rawlins. In addition, the availability of temporary housing is also described for the community of Craig in Moffat County, Colorado, and the community of Wamsutter in Sweetwater County, Wyoming, the closest and most likely sources of the available workforce. Socioeconomic conditions in Carbon County that were characterized in this document include economic and population conditions, temporary housing resources, law enforcement and emergency management services, certain local and state government revenues, and local attitudes and opinions.

3.12.1 Economic Conditions

The economy of Carbon County is based on natural resources. Basic economic sectors that bring revenues into the county include oil and gas production and processing, coal mining, electric power generation, agriculture (primarily ranching and logging), some manufacturing, and transportation (primarily the Union Pacific Railroad). Those portions of the retail and service sectors that serve travelers and tourism and recreation visitors are also basic.

Employment and earnings are two common measures of economic activity. The mining sector, which includes oil and gas employment, would be the primary sector affected by exploration or development of CBNG resources.

Employment, like the overall economy, has followed a boom and bust cycle. In 2000, employment in Carbon County totaled 12,392 full- and part-time jobs, which was about 25 percent higher than the 1990 level and about 9 percent lower than the 1980 level of 13,560 jobs (WDAI 2000a, 2003). Employment in the mining sector, which includes jobs in the oil and gas industry, decreased 76 percent from 1990 to 2000, from 934 to 223 jobs. The 2000 level was 94 percent lower than the 1980 level of 3,563 mining jobs (UW 1997). The losses in the mining sector and the volatility in total employment are attributed to the shutdown of the Rosebud and Seminoe # 2 mines (BLM 1999a) and more recently the RAG Shoshone mine near Hanna (Rawlins Daily Times 2000a). Other reductions in the mine workforce and the delay in opening an anticipated mine have further affected employment in the mining sector throughout Carbon County; however, increased natural gas drilling has resulted in growth in employment in the oil and gas industry in recent years (Schnal 2000).

In Carbon County, 10-year unemployment rates ranged from a low of 4 percent (2000) to a high of 6.1 percent (1993). In 2000, the total labor force in Carbon County was 8,357, which included 337 unemployed people, resulting in an unemployment rate of 4 percent (Wyoming Department of Employment 2003).

Earnings in Carbon County increased from $202 million to $211 million between 1990 and 1998, a 5 percent increase. However, when adjusted for inflation, earnings in Carbon County decreased by 21 percent from their 1990 level during the 8-year period.

3.12.1.1 Oil and Gas Production

Production of natural gas in Carbon County increased from 76 million cubic feet (MCF) in 1995 to about 97 MCF during 2000. In addition, production of oil in Carbon County in 2000 was within 1.6 percent of the 1995 level of 1.3 million barrels. During 1999, there were 742 producing oil and gas wells in Carbon County (WOGCC 1995-1999).

One indicator of future production, approved Applications for Permits to Drill, increased steadily in Carbon County in recent years, from 50 in 1995 to 162 in 2000 to 225 to date in 2003. Increased drilling may result in increased production in the county if drilling efforts are successful and commodity prices increase or stabilize at economic levels (WOGCC 1995-1999; WOGCC 2003).

3.12.1.2 Economic Activities

Other economic activities occurring in and near the Project Area include oil and gas exploration (Vosika Neuman 2000), cattle grazing (Warren 2000), and outdoor recreation such as hunting (pronghorn antelope, mule deer, elk, and upland birds), hiking, ORV use, camping, and sightseeing. The permit areas for many commercial hunting outfitters are partially within the Project Area (Clair 2000).

3.12.1.3 Population

The growth and decline in the population of Carbon County parallel the employment boom and bust cycle discussed previously in this section. For example, the 2000 population of Carbon County (15,639) was 29 percent lower than its 1980 level of 21,896 (WDAI 2001). Between 1990 and 2000, the City of Rawlins, the largest community in Carbon County, lost an estimated 842 persons to end the period at 8,538, although the city is growing because a new state prison opened. The Town of Baggs gained 76 residents or 28 percent of its 1990 population. Likewise, the Town of Dixon, several miles east of Baggs, gained 12 persons to end the period with an estimated population of 79.

3.12.2 Temporary Housing Resources

Natural gas development typically involves relatively short-duration tasks carried out primarily by contractors. The nature of these activities results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces in the Project Area and vicinity.

Most temporary housing resources are fully occupied by oil and gas industry workers during the summer in the area of Baggs and Dixon. More units become vacant during winter. A 26-space mobile home park in Baggs is equipped to accommodate RVs as well as mobile homes. There are several rental mobile homes within the park. There is a small four-space mobile home park in Savery, Wyoming, and a number of mobile home lots are scattered throughout the Little Snake River Valley (Grieve 2000).

There are two motels in Baggs with a total of 64 rooms, most of which can accommodate several guests. Both motels routinely house oil and gas industry workers as well as tourists, travelers, and hunters. As with mobile home parks, the motels are filled to capacity during the summer and fall, but some rooms are available during the winter. Most occupants who are employed in the oil and gas industry are relatively short term, residing in the community only during until work assignments are completed (Willis 2000; Hawkins 2000). Longer-term rental housing in the Baggs and Dixon area consists primarily of an apartment building and a newly constructed rental duplex.

Temporary housing resources are available in the Town of Wamsutter, including several mobile home parks and two motels (Carnes 2000). The town is the center of a 200-well per year British Petroleum (BP) drilling and field development program. Wamsutter officials recently stated that no housing was available in the town to accommodate workers

and their families associated with the current drilling and field development (Rock Springs Rocket Miner 2001).

More extensive temporary housing resources are available in Craig, Colorado, and Rawlins, Wyoming. The Craig Chamber of Commerce lists 12 motels with a total of 467 rooms and two campgrounds or RV parks with a total of 128 spaces (Craig Chamber of Commerce 2000). Rawlins has 20 motels and four RV parks (Hiatt 2000). There are also a substantial number of apartment buildings in these areas with some vacancies (Hewitt 2000; Rawlins Daily Times 2000b).

3.12.3 Local Government and State Government Revenues

The fiscal condition of local and state governments most likely to be affected by interim drilling includes ad valorem property tax revenues from the county, school, and special districts; state, county, and municipal sales and use tax revenues; state severance taxes; and federal and state mineral royalty distributions. Some county, municipal, and special district service expenditures may also be minimally affected.

3.12.3.1 Ad Valorem Property Tax

The assessed valuation in Carbon County for fiscal year (FY) 2001 totaled about $554 million, which yielded total property tax revenues of $34.9 million. Mineral production is assessed at 100 percent of value. The countrywide mill levy in 2001 was 12.76. FY 2001 assessed valuation from 2000 natural gas production totaled $363 million, or about 66 percent of total assessed valuation. Assessed valuation from oil production totaled 31.1 million, or about 6 percent of total valuation (WTA 2001).

3.12.3.2 Sales and Use Tax

FY 2000 sales and use tax collections in Carbon County totaled about $21 million. These collections include a 4 percent statewide sales and use tax, a 1 percent general purpose local-option sales and use tax, and a 1 percent specific-purpose local option sales and use tax, which expired in the summer of 2001 (WDAI 2000b).

3.12.3.3 Severance Taxes

In Wyoming, severance taxes are levied against certain minerals produced in the state, including a 6 percent severance tax on natural gas. In FY 2000, distributions from the severance tax totaled $275 million (WDAI 2000c). Of the total, 44 percent was attributable to severance taxes on natural gas.

3.12.3.4 Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. After certain costs are deducted, half of those royalties are returned to the state where production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the university, school foundation fund, highway fund, Legislative Royalty Impact Account, and cities, towns, and counties. During FY 2000, $309

million in federal mineral royalty funds were distributed to entities in Wyoming (WDAI 2000d).

3.12.3.5 State Mineral Royalties

The State of Wyoming collects a 16.7 percent royalty on the fair market value of gas produced from state leases, less production and transportation costs. During FY 2000, state-leasing income was $35 million (PRCBMIC 2001).

3.12.4 Attitudes and Opinions

A 1996 survey conducted in conjunction with preparation of the Carbon County Land Use Plan provides some insight into the attitudes and opinions of residents regarding land use, oil and gas development, natural resource conservation and use, and other topics. Slightly more than 300 residents completed the survey, yielding an estimated statistical reliability of about 95 percent (Pederson Planning Consultants 1998).

Water resource conservation and concern for government regulation of land use were the most frequently listed land use issues. This issue was followed closely by the availability of water to support future land uses; the economic viability of ranching, timber, and oil and gas industries; and the need to conserve wildlife habitat.

Approximately 55 percent of countywide survey respondents (based on a weighted average; some respondents indicated more than one response) indicated that conservation of land, water, and wildlife resources was more important than increased oil and gas production, while 36.9 percent indicated that increased oil and gas production was more important. However, 54 percent of the respondents from Baggs indicated that increased oil and gas production was more important than conservation of land, water, and wildlife resources, while 36 percent indicated that resource conservation was more important. The land use plan attributes this difference to the greater economic dependence in Baggs on future oil and gas employment.

Concerning management of federal lands, the largest number of respondents (69.5 percent) indicated that more federal lands within the county should be designated for conserving fish and wildlife habitat and surface water and groundwater resources. In addition, 60.8 percent of respondents indicated that more land should be designated for public recreation, 48.8 percent indicated that more land should be leased for oil and gas industry exploration and production, 48.7 percent indicated that more land should be leased for commercial mining, and 44.5 percent indicated that more land should be made available to local timber companies for commercial timber harvest.

3.12.5 Environmental Justice

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations," was published in the *Federal Register* (59 FR 7629) on February 11, 1994. EO 12898 requires federal agencies to identify and address disproportionately high and adverse effects on human health or the environment

of their programs, policies, and activities on minority and low-income populations (defined as living below the poverty level). The EO makes clear that its provisions apply fully to American Indian populations and Indian tribes, and specifically to effects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Indian communities.

Communities within Carbon County and entities or individuals with interests in the area may have concerns about the presence of development within the Project Area. Communities potentially affected by the presence or absence of the proposed development have been identified in the previous sections. Environmental justice concerns are usually directly associated with impacts on the natural and physical environment, but these impacts are likely to be interrelated with social and economic impacts as well. Environmental justice concerns focus on promoting the protection of human health and the environment, encouraging public participation, and disseminating relevant information to educate potentially affected communities.

Native American access to cultural and religious sites may fall under the umbrella of environmental justice concerns if the sites are on tribal lands or access to a specific location has been granted by treaty right. With regard to environmental justice issues affecting Native American tribes or groups, the Project Area contains no tribal lands or Indian communities, and no treaty rights or Indian trust resources are known to exist for this area.

3.13 TRANSPORTATION

The regional transportation system that serves the Project Area includes an established network of interstate and state highways and county roads. Improved and unimproved BLM roads serve local traffic on federal land.

Federal and state highways providing access to the Project Area include U.S. Interstate Highway 80 (I-80) Wyoming State Highway (WY) 789, WY 71, and WY 70. The Wyoming Department of Transportation (WYDOT) measures annual average daily traffic (AADT) and collects accident statistics on federal and state highways. AADT and accident statistics for highways providing access to the ARPA are shown in Table 3-14.

WYDOT assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, and comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. “A” represents the best travel conditions, and “F” represents the worst. Levels of service for highways providing access to the Project Area are also shown in Table 3-14**.**

The primary roads used to reach the Project Area are Interstate-80 to WY 789 or WY 70 to WY 789, both of which lead to Carbon County 608 (Wild Cow Road), an existing graveled road. An existing BLM road provides access from Carbon County 608 to T16N R92W, Section 12. Access from the southwest to the drill locations would be provided by newly constructed road access along existing two-tracks that currently provide vehicle

access and newly constructed road access. BLM 3305 provides access to the southeastern edge of the Project Area, including the Sand Hills and the eastern flank of Doty Mountain, via unnamed roads and two-tracks.

TABLE 3-14 HIGHWAY ACCESS, ANNUAL AVERAGE DAILY TRAFFIC AND ACCIDENT STATISTICS

Highway	2000 AADT	Projected AADT in 2012	Levels of Service/Annual Average Accidents 1996 –2000
I-80 from Rawlins west to Creston Junction	10,900	15,000	A/123.4
I-80 from Rock Springs east to Creston Junction	10,900	15,000	A/246.6
WY 789 from Creston Junction south to Baggs	760	800	B/18.8
WY 70 from Savery west to Baggs	530	550	B/14.8
WY 71 I-80 south	160	160	B/3.2

Source: GHEP 2003

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the Project Area include occupational hazards associated with natural gas exploration and operations; risks associated with vehicular travel on improved and unimproved county and BLM roads; firearms accidents associated with hunting or casual use of firearms; and low-probability events such as landslides, flash floods, and rangeland fires.

3.14.1 Occupational Hazards

Two types of workers would be employed by the project: oil and gas workers who in 1998 had an annual accident rate of 4.0 per 100 workers, and special trade contractors who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 1998). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There has been recent concern among drillers that worker safety standards and training used for conventional oil and gas may not be appropriate for the CBNG industry (Rock Springs Rocket Miner 2001). During 2000, five workers died and six others were seriously injured in CBNG-related accidents in Campbell County, Wyoming. The Wyoming Occupational Safety and Health Administration (OSHA), Worker's Safety Division, is working with companies to consider changes in standards for worker safety and revised training requirements.

3.14.2 Pipeline Hazards

Accident rates for gas transmission pipelines are historically low. Nationwide, injuries associated with gas transmission pipelines averaged 12 per year from 1990 through 2001, fatalities averaged one per year, and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 2002).

3.14.3 Other Risks and Hazards

Hazards would exist from sanitation and materials used during oil and gas development. Federal regulations establish standards for safety procedures during drilling, including blowout prevention equipment to control abnormally high pressures, if encountered during drilling operations, and procedures to be employed for the control and removal of wastes, spill prevention, fire prevention, and suppression. The existing risks associated with wildfire in the Project Area have not been characterized or quantified for either natural or human-caused ignitions. The handling, storage, transportation, and disposal of hazardous materials, if any are used, also are regulated. A spill prevention, control, and countermeasures plan is required.

The types of materials used in the development of CBNG are materials that are often found in a garage at a residence, including ammonia, gasoline, diesel fuel, motor oil, greases and lubricants, solvents to clean equipment, antifreeze-type heat transfer fluids (glycols), paint, sand, fertilizers, and herbicides (weed killers). Additional materials that are typically used are solutions that are used to regulate acidity and alkalinity, such as those that could be used for spa maintenance, including sodium hydroxide, and acids. Surfactants (soap-like materials), inert gases that are not toxic, flammable, or explosive, and welding or cutting materials also are used.

3.15 NOISE

The Project Area is located in a sparsely populated rural setting with minimal sound disturbances. Vehicle traffic on WY 789; overflights by jet aircraft at high altitudes; localized vehicular traffic on roads; and nearby drilling cause sound disturbances within the Project Area. The principal source of sound within the Project Area is the wind. The U.S. Environmental Protection Agency (EPA) has established an average 24-hour noise level of 55 A-weighted decibel (dBA) as the maximum level that does not adversely affect public health and welfare. The State of Wyoming has not established regulations for quantitative noise levels. Definitive data have not been established concerning noise levels that may affect animals.